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Electrical Review

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A great many makers of electrical instruments and devices adhere to the old order of things in continuing the use of brass castings and punchings for the frames and parts. This in the face of the proven success of various alloys of aluminum, which, while possessing the required conductivity and strength and great lightness, permit of a more pleasing finish. It is probably merely because they have all been so busy in the great boom which has come on the electrical field that they have not had time to attend to the necessary details governing such a change.

Where is the genius who should long since have overcome the situation brought about by the destruction of the telegraph line into Pekin? Every war has its Washington, its Wellington, its Dewey; every battle has its hero; and hitherto every conflict in mechanical science has brought forth gray matter in abundance. But at Pekin the world is blocked. The armies and navies of the nations are at the threshold of that city equipped with every device that electrical and heliographic science can lavish upon them, and yet it seems impossible to do anything to replace or substitute the slender wire that once bridged the few miles intervening. We need the inspired brain, but, as yet, it has not appeared.

Wireless telegraphy seems to have passed through its period as a nine-days' wonder and to be taking a less prominent position than it once occupied in the electrical field. It is greatly to be hoped that the ingenuity of inventors will devise means to overcome the several difficulties which surround its reduction to practice as one of the working means of communication. Foremost among these is the apparent practical impossibility of preventing the interference of simultaneous signals in the same region of influence, or, what amounts to the same thing, the production of a selective system for several stations whereby any two can communicate without interfering with the others. Until this is done, the utility of the system, beautifully ingenious as it is, seems to be confined within extremely narrow limits.

The article on another page concerning the Pacific cable, by Mr. Chandler Hale, is an able argument for the so-called northern route, as distinguished from the proposed southern route, *via* Midway Island, Guam and Hawaii. No argument is needed to exhibit the immense importance of such a line, and there is little doubt that with equally great advantages of construction and operation the southern route possesses the greater desirability in having all its landings on United States territory; but the northern route has a number of peculiar advantages, among them being that the selected route is very nearly confined to a great circle of the earth's surface, and, therefore, is the shortest distance between the terminal points. The only advantage that would be possessed by the southern cable would be strategic. It seems, however, in the light of recent experience, that its great length coupled with the exceeding vulnerability of cable property, would give an active enemy a free opportunity to destroy the line of communication, even if all its landing points were fortified and garrisoned. The strategic advantage is, therefore, less than it appears to be, while the commercial advantage accruing from the choice of the northern route would be very great. As Mr. Hale points out, there is reasonable expectation of the growth of a commercial metropolis of the North Pacific at Dutch Harbor. How much this would be encouraged by the presence of the cable it is impossible to overestimate.

TROLLEY HORRORS.

The criminal carelessness which permits modern trolley cars weighing many tons to be overcrowded with passengers, put into the hands of one man and driven at high speeds on ill-constructed tracks and then does not provide any adequate means for stopping the car in case of emergency should be a subject for the action of the Grand Jury. The newspapers have just contained an account of a horrible accident taking place in Tacoma, Wash., on July 4, when over one hundred people were killed or injured in an accident little less terrible than some of the frightful catastrophes that have marked the history of steam railroads.

There is absolutely no excuse for this kind of carelessness which is worse than criminal. If there were not well-known power-brake appliances and if it were not a thoroughly understood fact that the low flanged wheels of the ordinary car truck are not adapted for high speeds, there might be a shadow of excuse for the railway company that thus permits the public to be butchered on its lines. But these things are well known. There is an abundance of trolley road and car construction which leaves little or nothing to be desired. Perhaps after all the most serious feature of the negligence, which in this case has cost so much life, is the almost universal practice of allowing motormen to make up time and run down hill as fast as they please.

The ordinary hand-brake is practically useless in handling a large double truck modern car at high speed. It will answer very well for service in streets where the speed limit is only a few miles an hour and where the grades are slight, but for suburban lines where the cars are frequently sped up to velocities of 30 miles an hour or more, it is ridiculously inadequate. To expose valuable lives to the danger of horrible disaster where no other means than this impotent device is at hand for protection deserves the severest condemnation that it is possible to give it. It is not always the motorman who is at fault, for too frequently he has proven himself cool and self-sacrificing in emergency; it is the management that compels a man to take the lives of his fellow-creatures in his hand daily and hourly and gives him no better protection than a hand-brake invented for the good old one-horse car of our forefathers.

From the experience of such disasters as this it would seem that street railway managers could learn something. A few more such and the present enormous popularity of the trolley as a cheap and satisfying excursion will grow very much less; people will be afraid to ride in cars where they are exposed to such dangers. It is to be hoped in the interest of justice that a vigorous persecution will be made by the local authorities at Tacoma, and the guilty persons connected with this inexcusable catastrophe brought to justice.

ELECTRIC FIRE ENGINES.

The prevalence of disastrous fires in the neighborhood of New York city, and in the city itself, during the month past emphasizes the value that electric fire engines would possess. In the district south of One Hundred and Twenty-fifth street, in Manhattan Borough, there is gathered together a total of property liable to injury by fire which mounts into stupendous figures. With the present system of open-conduit electric railroads, only in the extreme "East Side" is there any neighborhood in this great area more than four or five blocks from the nearest conduit. When the equipment of the Belt Line and the elevated railways are completed the whole of Manhattan Island will be veined with electric conducting systems, any one of which can furnish, at a moment's notice, several hundred horse-power of electrical energy at any point of its length. An electric pump able to maintain several heavy streams can be mounted on wheels so that the whole will be lighter than one steam fire engine, with its boiler, capable of maintaining only one such stream. A coil of cable, with some simple, quick-acting connector to allow it to be instantly coupled to the railway feeder system, is all else that is needful. Such an outfit would be easier to handle, especially in snow, because of its lightness, and would be both more reliable and more powerful in operation. Arrangements for the use of the railway current could, doubtless, be made very easily. The suggestion seems to be worth carrying out, as an experiment, at least, for the salvage such a machine might accomplish in any one instance would far outweigh the cost of a trial.

FLAG POLES.

When a high steel building stands up above its fellows it forms a peculiarly shining mark for a lightning stroke. If the metallic cornices, finials, etc., of the building are in connection with its metallic frame, lightning can strike the top of the building repeatedly and do no damage. It amounts, under the circumstances, to a handsome and interesting pyrotechnical display and nothing more.

When the building is topped by a high, wooden flagstaff, however, conditions are different. Merely from their elevated position, these flagstaffs, offering an alluring bait to the lightning, become a source of danger. The building on which they stand is, of course, not injured by the destruction of the flagstaff, which is often riven into splinters. In an instance of the striking of such a pole on one of New York's skyscrapers a few days ago, such splinters, ranging in size from mere tooth-picks to pieces as big as a man's body, were scattered broadcast from a height of over two hundred feet into one of the busiest of the narrow down-town thoroughfares. That nobody was injured was simply a providential miracle.

If it is necessary to mount a flagstaff on a high building, especially in a position where its fragments may descend upon passersby, let it be a metallic flagstaff by all means. Probably the only repairs a lightning stroke would necessitate on such a pole would be a new coat of paint, and there would be no splinters.

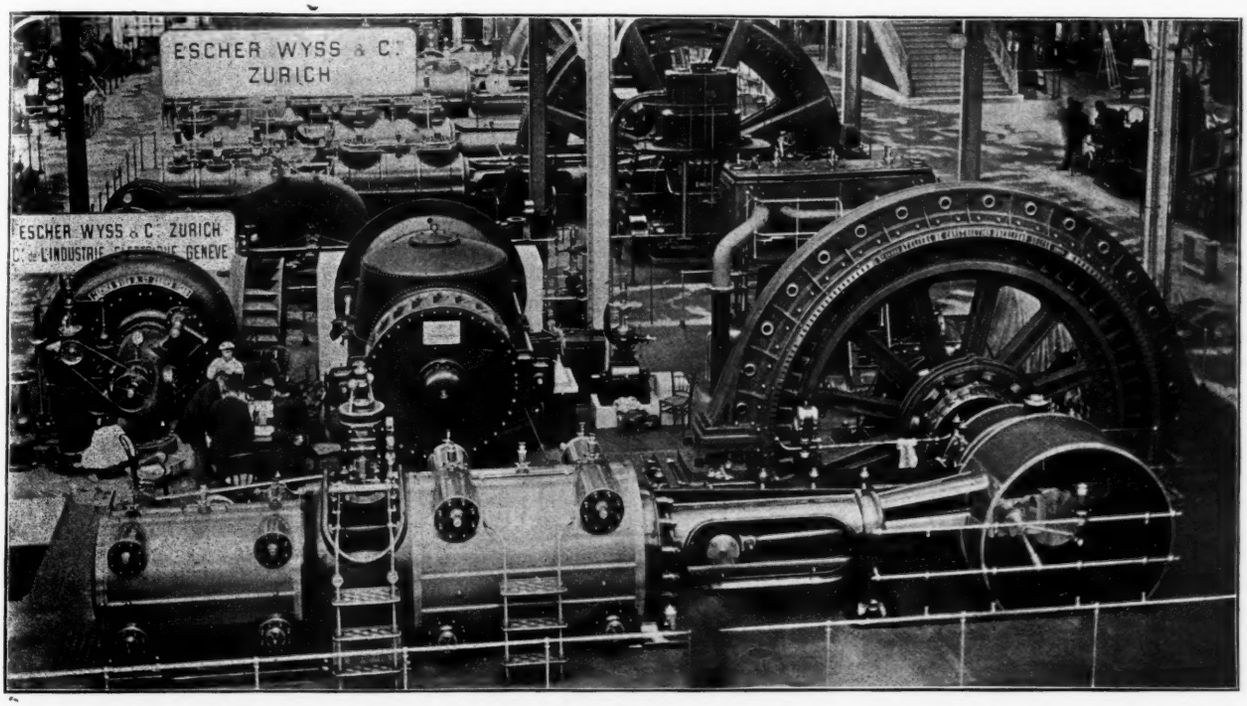
What has become of Szczepanik, the Hungarian inventor who was going to exhibit a marvelous machine called the telelectroscope at the Paris Exposition? This instrument was described as a machine whereby one could see through a wire by electrical means, just as with the telephone one can hear to great distances. It was solemnly promised that it should be revealed to an admiring world at Paris this Summer, but, although the exposition is now nearly half over and nearly half complete, no signs of the telelectroscope or of any preparations for it are discernible. Horrible thought!—has the inventor been so unfortunate as to fall over his own name and get tangled up with it?

GERMAN EXHIBITS AT THE PARIS EXPOSITION.

BY C. L. DURAND.

The German exhibits on the upper floor of the Electrical Palace are among the most interesting of the section. The principal structure is that which has been erected by the Allgemeine Gesellschaft, of Berlin; it is built of staff and is highly ornamental in character, having at the top a cupola in gilded ironwork. It is surrounded on the different sides by displays of electrical apparatus and instruments manufactured by this company. On one side of the pavilion is an extensive collection of three-phase motors and direct-current motors of small sizes; a number of large ventilating fans are also to be seen, with different forms of motors. This firm also makes a three-phase motor set mounted with driving gear complete, and intended for use with machine tools, etc. At one corner are a number of drills operated by three-phase motors, and types of portable drill in which the motor is mounted upon a carriage, the drill having a flexible coupling. Another display includes a number of arc projectors and a large collection of alternating and direct-current arc lamps of various types, some of which are highly ornamental, these have opal and clear globes, and the mechanism is, in many cases, enclosed in glass so as to be clearly visible. The lamps are finished in bronze, copper, black finish, etc. A number of projectors with incandescent lamps are shown; some of these are portable and are mounted on a case containing the battery. On one side of the pavilion is a large collection of measuring instruments for station and laboratory use, including a number of different types of wattmeters. Among the novelties is a kilowatt meter in which the indications are made by figures placed around the peripheries of small wheels placed side by side, after the manner of a speed-counter. A new form of instrument for measuring difference of phase is to be seen, and a number of switchboard transformers for two or three-phase circuits, besides portable voltmeters and instruments for laboratory use. Another collection includes a series of switches of all sizes, two and three-pole, automatic circuit breakers, circular switches and contact boards of different forms. A number of large induction coils, entirely enclosed in a gutta-percha covering, are also to be seen. Another group of apparatus includes a number of wall cutouts, fan motors of different sizes, besides a number of rheostats, some of these being of the liquid type. A large three-pole switch for high-tension work is shown; it is mounted entirely in glass, and the different sets of contacts separated by heavy glass plates. The interior of the pavilion contains a central room with a vestibule at either side; it is richly decorated with frescoes and ornamental lamp fittings. The frescoes show different views in the lamp factories and other parts of the company's works, besides a number of allegorical figures of artistic design.

Adjoining this pavilion is the exhibit of Siemens & Halske, which occupies a considerable space. The central portion is of handsome design, and consists of an ornamental structure having on either side a column surmounted by relief heads; an arch of stained glass extends across, bearing the name of the firm. Below is a platform with a balustrade in front, and two staircases lead down on each side to the floor level. Below is an extensive space for the different exhibits. In the centre is a marble bust of Werner von Siemens. A part of the exhibits is also contained in two spaces arranged on each side of the passageways, and these are connected with the main section by a cupola of gilded ironwork and stained glass. The whole is bordered by rows of colored lamps. In the central portion is a collection of different apparatus; a large table contains a display of small direct-current and three-phase motors, armatures, etc.; at the side is a portable projector mounted on a tripod, also different systems of lamps for mine lighting, a series of colored lamps in cases for signaling, different forms of rheostats and other apparatus. On the other side is a collection of automatic regulators and rheostats for station use, and two large automatic circuit breakers for 1,500 and 3,000 amperes; a circular rheostat with carbon contacts is also to be seen.



A VIEW IN THE GERMAN SECTION OF THE ELECTRICITY BUILDING AT THE PARIS EXPOSITION.

On the large panel above the central arch is a display of junction boxes and conduits, showing the method of making connections; at the sides are cases of cables and wires of different forms, and a collection of switches with slate bases. The four adjoining spaces are finished in hard wood and contain each an exhibit of a different character. One of these is devoted to measuring instruments of different kinds, mainly of the laboratory type; here are a number of reflecting galvanometers and scales of different kinds, with telescopes and accessories; a number of standard resistances for laboratory measurements are seen, and a set of induction coils of different sizes, with various forms of dynamometers and portable measuring instruments. An interesting piece of apparatus is that used to measure the flux density in a given sample of iron; the iron is placed in the circuit of a testing magnet at one side and a dial gives the readings directly in units of induction. Another novel instrument is a portable cable-testing set with galvanometer, keys, etc., mounted on a base which is provided with a cover for transportation; when the cover is removed, a tripod is formed by bending down three hinged rods arranged for the purpose. The exhibit includes a number of resistance sets for laboratory use and portable forms. A number of ohmmeters are shown, and various types of wattmeters, some of which are designed on the Ferraris system.

The adjoining space is devoted to telephone, telegraph and fire-alarm apparatus; in front a table contains a number of desk telephone sets, some of which are of a highly ornamental pattern, being designed in bronze and other metals; the handsomest of these is a carved ebony box with the telephone sets in gold-plated mountings. The exhibit contains an extensive collection of fire-alarm apparatus, including several street boxes mounted upon pillars, and different wall types. A series of electric railroad signals is also shown, as well as types of electric mine fuses, registering meters, cable heads and junction boxes, wires and cables. On one side is a collection of wall telephone sets of various patterns, as well as electric bells and large gongs. In front are two tables, one containing a printing telegraph outfit and the other a Morse registering set; the section contains also a number of arc lamps, magnetos, dry batteries, etc. Of the two remaining spaces, the first is occupied by an extensive display of marine signaling apparatus. The centre has three large ship indicators, mounted upon iron columns; these are used to give the steering indications. A fourth indicator is used for artillery signals. On the walls are mounted different systems of bells and apparatus for marine signals, and two boards of submarine cables, with different forms of junction boxes. The other side has different sets of marine signaling apparatus and telephone systems. The second space is almost entirely occupied by a large telephone switchboard of the horizontal pattern, about 15 feet long; it is divided into six sections. The central plug board is constructed mainly in ebonite, the switchboard is designed for a station of 14,000 subscribers. At the end of the board is shown a section, covered by a glass plate; in this way the arrangement of the interior, with the different parts of the apparatus, wires and connections, may be clearly seen. The remainder of the space is occupied by different forms of telephone junction boxes and terminal heads for cables, lead-covered cables and an iron pole-top with insulators. A number of desk and wall telephone sets are also shown here.

The Physico-Chemical Institute of Göttingen University has an interesting exhibit, showing an experimental work-table fitted with different forms of instruments used in electrochemical and physical work. Among the different instruments shown are those for determining the dielectric constant, apparatus for electrolytic analysis, induction coils, reflecting galvanometers, measuring instruments, etc. A photograph of the institute is shown, and of the Gauss-Weber monument. Next to it is the exhibit of the Aron meter, and types are shown for use with direct and alternating current; a number of wattmeters are also to be seen, adapted for particular purposes, such as the charge and discharge of accumulators, also a watthour counter with an automatic winding attachment, and a meter on the prepayment system, which operates by placing a coin in the slot. The exhibit of the Dr. Paul Meyer Company, of Berlin, contains different types of measuring instruments for station and laboratory use, circular switches, a collection of automatic cutouts of different sizes, fluid resistances, portable megohmmeters, also a large circuit breaker for 300 amperes at 2,000 volts, and other station apparatus. Kaiser & Schmidt, of Berlin, have the next space, which contains a collection of ammeters, resistance boxes, an astatic galvanometer of the reflecting type with four mirrors, a portable insulation tester working to one megohm. A new type of pyrometer is shown, designed on the Le Chatelier system. On the end of a rod is carried a thermoelectric couple of platinum and platino-rhodium, which is connected by wires to a galvanometer designed for the purpose, reading directly in degrees. A mirror galvanometer of the Deprez-D'Arsonval type is shown, a number of spark coils for automobiles, as well as a telephone set of the model adopted by the German Government, and another set arranged for three circuits. The exhibit of the Luxsche Industrie Works, of Leipzig, shows a number of wattmeters of various types and a number of incandescent lamps and switches. A large case contains the exhibit of instruments made by the Physico-Mechanical Institute, under the direction of Dr. Edelmann, of Munich. A number of laboratory instruments are shown, among which may be mentioned a megohmmeter for localizing faults in cables, different forms of mirror galvanometers and scales, a torsion galvanometer, a portable cable-testing set, etc.

Among the German exhibits that of Schuckert & Company occupies a prominent place. It contains a panel board with various types of wattmeters, besides a collection of small dynamos and rheostats. A prominent feature of the exhibit is a series of large concave mirrors for arc projectors, and a number of complete projectors are also to be seen. Upon a large table in front are placed a number of heavy pieces of apparatus for station use, including a series of automatic circuit breakers of large size and automatic regulating apparatus of different types; an interesting exhibit is that of a series of arc lamps, six in number, showing the successive types of arc lamp used by the firm from 1879 to 1899; a diagram at the back of each explains the action of the mechanism. Near this exhibit, Hartman & Braun, of Frankfort, have a display of station and measuring instruments, mounted upon three handsome marble panels of large size; a fourth panel contains a number of ohmmeters, registering wattmeters and other instruments. The exhibit of Voight & Haffner occupies the space next to the United States Pavilion; in the centre is a large marble panel which is one of five similar panels belonging to a switchboard for a 10,000-volt circuit, of the type used at Cherasco, Italy, and at two large stations in London. All the parts are carefully designed; the measuring instruments are flush with the surface of the board. A number of other switchboard panels are shown, upon which are mounted different types of dynamo switches, circuit breakers, improved forms of fuse blocks and automatic regulators.

The exhibit contains also a number of controllers for electric cars.

The Swiss National Pavilion is devoted principally to a large collection of photographs and maps and drawings showing the various hydraulic plants in that country. The central space is occupied by four cases, each containing a model showing the arrangement of the hydraulic plants. The first two represent the sections of the Geneva plant, at Chèvres, showing one of the turbines with the dynamo mounted above, the water gates and other arrangements. The machine parts are cut out of white wood and very carefully made; the turbines and dynamos are shown partly in section and the operation of the plant is well illustrated. The third case contains a model of the entire plant, showing the dam and the station building with the roof partly removed to show the machines; there are 15 groups of turbines and dynamos represented in miniature, the scale being 1 to 250; each is rated at 800 to 1,200 horse-power, giving for the plant a total of 12,000 to 18,000 horse-power. The dam has six gates; the power-house is shown in successive sections of which the different working parts are seen. A second model of similar construction shows the Coulouvrenier hydraulic plant, which supplies the city of Geneva. It is constructed to the same scale.

The pavilion is divided into three parts by partitions and the walls are covered by collections of photographic enlargements showing the interior and exterior of the different Swiss stations, with the substations, and details of the turbines, dynamos and transformers. About 10 of the principal hydraulic and steam plants are illustrated in this way, and each set is accompanied by a large section of the station taken through the turbine or engine and dynamo, and in most cases a plan view is given. The Geneva-Chèvres station is illustrated in this way, also that of Rheinfelden, containing 20 machines of the revolving field type. The Zurich station is also shown, and that of Combe-Garot, which has nine machines. The Rathausen station, near Lucerne, shows the alternators of the Brown-Boveri type in plan and section, with the canal, substation, transformer posts, etc. The Kanderwerk plant, on Lake Thoune, is well illustrated, showing the system of distribution to the city of Berne and the electric road from Berthoud to Thoune, with the type of motor car adopted, as well as an electric locomotive used on this line. Another set of photographs shows the electric railway which passes up the Jungfrau, with views of the central station, the trains and type of locomotive adopted.

The French Government collection of historic apparatus contains a great number of specimens of electrical instruments and apparatus which have been gathered from different sources. The smaller apparatus is contained in a series of cases which surround a large central space in which are placed the dynamos and heavy apparatus. The collection is a very extensive one and contains a great number of specimens illustrating the early history of electrical work. It includes a number of types of the Jablochkoff candle, two incandescent lamps of the Lodyguine type made in Paris in 1875 or 1876, and a number of arc or incandescent lamps of early types. Among the telegraph instruments may be mentioned a needle telegraph of the Breguet pattern, several types of receivers, a dial telegraph on the Froment system, and others. An interesting piece of apparatus is one of the original thermoelectric piles made by Clamond; another of the Pouillet system is also shown. A number of early specimens of galvanoplastic work is to be seen, and several types of Leclanché battery. Among the heavy apparatus is a number of frictional electrical machines dating from the last century, and several early forms of dynamos of the Gramme and other types. An interesting specimen is a Pixii magneto machine, constructed under the direction of Ampère; it is loaned by the laboratory of the Sorbonne.

In the illustration is shown a view taken in the Swiss section, which is now completely finished; the large generating set in the front consists of a three-phase alternator of 500 kilowatts, built by the Oerlikon Company. It gives normally 2,200 volts, with a capacity of 125 to 135 amperes, working at 50 cycles; the engine is of the tandem compound type and is constructed by Escher, Wyss & Company, of Geneva; it is rated nominally at 900 horse-power. In the rear of the exhibit may be seen two large turbines, which have been built by the same firm. The large turbine in the centre is of the Francis type, rated at 2,500 horse-power; it runs normally at 160 revolutions. The second alternator seen in the rear is also one of the large machines which furnish power for the exposition. It is of the monophase type, having a capacity of 400 kilowatts at 2,200 volts. It has been built also by the Oerlikon Company. The engine, of 400 horse-power, is of the Sulzer type, a cross compound. The small upright engine in front of the alternator is also of the Sulzer make, and is direct connected to an alternator of the Oerlikon type.

Paris, June 25.

AUTOMOBILES

The Electric Vehicle Company, 100 Broadway, New York city, has issued a sumptuous catalogue of the Columbia electromobiles and gasolene automobiles. The book is from the press of Bartlett & Company, is printed in two colors, and is a striking example of the printer's and engraver's art. The vehicles illustrated and described cover every possible service, and the catalogue should be in the hands of everyone interested in horseless vehicles.

The Bavarian Government recently set aside the city ordinance preventing the use of automobiles on the streets of Munich, according to a dispatch from United States Consul Worman at that place. This, says the consul, opens up one of the best German cities for American manufacturers of horseless vehicles. Munich is the third largest city of the German Empire. Her streets are well-paved, bicycles are popular and horses dear. This opening should not go long neglected.

Mr. Dwight W. Bowles, business manager of the Chicago *Inter-Ocean,* informs the ELECTRICAL REVIEW that in response to a petition signed by 15 of the largest manufacturers in the country the Chicago *Inter-Ocean* has agreed to postpone the first International Automobile Exhibition and Race Meet to Tuesday, September 18 to Saturday, September 22, inclusive. The manufacturers explained that as this is to be one of the greatest shows ever held in America, they desire to be fully represented and consequently needed more time than was allowed by the first dates. A preliminary programme has been issued, which is open for suggestions and corrections from manufacturers and any one interested, up to July 15, at which time a final programme will be adopted, and, after that, can not be changed. The events will take place at Washington Park, on the finest mile track in the world. A brilliant system of electric lighting will be arranged for night racing. The grandstands have a capacity of 50,000, and the transportation facilities to and from Washington Park are ample. These events will be the first of the kind to be held on a track and will doubtless attract attention all over the world. Those interested may obtain further particulars by writing to Mr. Bowles in care of the Inter-Ocean Publishing Company, Chicago, Ill.

NOTES ON LIGHT.

BY WILLIAM ROLLINS.

NOTE XCIX—ON TUBES FOR GENERATORS OF LOW POTENTIAL.

To get brilliant X-light with a small expenditure of force it is necessary to have a vacuum so high that particles of gas rushing from the terminals may meet with the least possible obstruction. When we attempt to use such a tube with a generator of low potential we can not, unaided, overcome the initial high resistance due to the force of attraction which holds the gas particles to the terminals. When we begin to pump a tube, sending the current through it, these particles come off in great numbers, so only by continued running until those remaining are held with a force which requires several thousand volts to overcome, can a tube be brought to a condition to produce X-light efficiently. Indeed, I have already shown that pumping is but a small part of the preparation of an X-light tube. With a good pump an X-light vacuum can be produced in a short time, but to remove enough from the terminals is a far longer process. To overcome the initial high resistance of a tube which has been properly prepared, a holder was arranged into which heat could be introduced while the tube was in use, the temperature being easily raised to as high degree as the glass would bear without getting soft.

When the vacuum had been lowered by heat (from gas driven from the glass), and the resistance to the formation of the Varley cathode stream made less (by heat having partly overcome the attractive force between the gas and the metals of the terminals), the low-potential generator had then the power to push gas particles from the cathode and drive them against the target with sufficient force to produce X-light. When the current was started the vacuum by continued running fell and the tube produced too many heat waves and too few X-light waves, because the particles from the cathode did not strike the target with sufficient force. As this state came on, the temperature of the tube was allowed to fall, until a condition was reached where, by a balance of the forces, the character of the light was maintained constant; it being only necessary to allow the tube to cool more as the number of particles in the circulation increased, thus condensing them on the glass. For repeating this experiment a tube should be in good condition, that is, the attraction between the remaining gas and the metal of the terminals should be of the proper degree for the generator with which the experiment is carried out.

In those cases mentioned in former notes, when by long use the resistance has grown so high (from continued exhaustion of the gas from the terminals), that a convenient degree of heat will not allow the current to liberate enough gas to form a Varley cathode stream, we can no longer use the tube on a low-potential generator without other treatment. At this time I do not know the best way of recharging exhausted terminals, though I have made many attempts. I formed a theory that if the cathode could be heated it would take up gas as it cooled, the gas being obtained from the supply collected by the glass in the normal working of the tube, as it was forced from the terminals.

In one of my experiments I used a tube somewhat like the one shown in Fig. 59, note lxv, only that there was a hinge in the stem of the target so it could be dropped out of the field when the tube stopped working on account of the terminals being exhausted. In pumping, the tube was maintained at a temperature of 500 degrees Fahrenheit to expel gas. The left hand aluminum disk was cathode and the target was anode. Then the target anode was dropped out of the field and the right-hand concave terminal made cathode, the hinged terminal an anode and connected with the generator serving the left-hand concave aluminum disk not only as a target to receive the impact of the Varley cathode stream from the right-hand disk. After an hour the current was stopped, the left-hand concave disk allowed to cool, the tube being maintained at an unvarying temperature. When the tube was afterward allowed to cool it gave X-light with the current passing in a normal direction. I therefore concluded that the experiment showed there was some truth in the theory and I appeared to have pointed out a direction in which valuable work might be done. This experiment is not offered as a satisfactory way of solving the problem of renewing exhausted terminals, but now that Trowbridge has discovered that X-light tubes can be excited by simply connecting the terminals to a storage battery of only 20,000 volts, these observations of mine may be of sufficient interest to mention, because with such a generator the cathode will be rapidly exhausted from the increased amperage we shall be tempted to use, for more amperage means more light, which is most desirable in medical work. As this new type of generator is perfectly silent it will be of the greatest value in studying the heart and lungs by means of some apparatus such as shown in Figs. 46 and 47, note xlvii.

NOTE C—DOES THE ETHER CONDUCT?

When two great men make statements which appear to oppose each other it is always desirable to find some reconciliation which may serve as a working theory to guide experiments. I have tried to do this with the statements which follow, to help me in determining the phenomena of X-light tubes.

Maxwell said that conductors were opaque. The ether therefore can not conduct, for it is the type of transparency. But Trowbridge concluded a remarkable paper read before the American Academy of Arts and Sciences, April 1897, with these words: "I am thus forced to the conclusion that under high electrical stress the ether breaks down and becomes a good conductor." If as stated in a former note, we imagine the ether to be disassociated when we apply sufficient energy, we appear to reconcile these statements, for normal or whole ether is transparent and serves as a medium for the changes we call waves, but does not conduct. When disassociated, its particles forming new combinations with the differentiated ether we call matter, its properties are so changed as to give rise to the phenomena we call electricity and conduction.

NOTE CI—CONDUCTION IS A PHENOMENON OF MATTER.

The fact of amalgamation between solids and gases with its accompanying ether phenomena under stress, appears to be of value to those who are working in the ether over a wider field than that of an X-light tube, extending even to gravitation itself, which latter aspect will be spoken of later. If we could remove all the particles of matter from a tube we should find it would not conduct, however high the electro-motive force, until we reached a stress sufficient to overcome cohesion. When this point was arrived at (which, by the way, I find differs for different substances under electric stress, as it does under mechanical and chemical), particles of the terminals would then serve as carriers for the disassociated ether and would rush across the field, producing again the phenomena of conduction. If there were no internal terminals then the glass would act as such and would go. Normal ether does not conduct, but transmits energy by motions which we, living in deep shadow and unable to discover the truth, call waves.

NOTE CII—MAXIMUM X-LIGHT ARISES IN THE FIELD OF GREATEST ETHER STRAIN.

In earlier notes an attempt was made to show, that contrary to the accepted opin-

ion, the direction of the cathode stream, and therefore the chief area from which X-light arose, was influenced by the position of the anode in relation to the target (Note xv, Fig. 1). If, therefore, the phenomenon of X-light is a result of a stress applied to the ether, we should expect the effect to show most between the terminals, and this would explain why there was no X-light coming from the normal target in Fig. 1, when the ring was made anode, for the normal target was too far from the field of maximum strain,

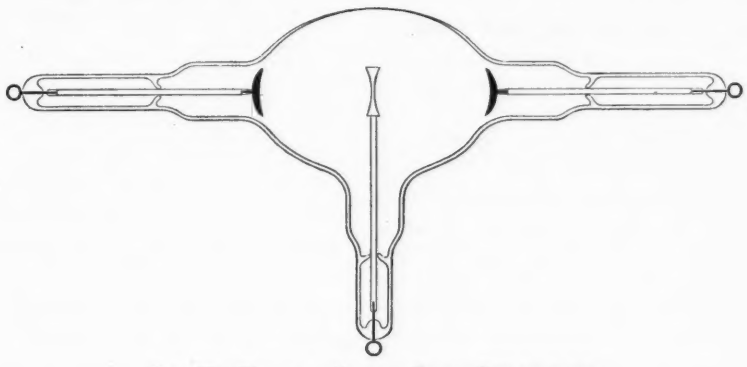


FIG. 75.—NOTES ON LIGHT. SCALE ONE-QUARTER.

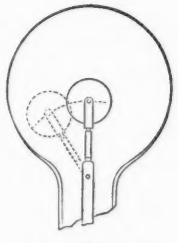


FIG. 78.—SECTIONAL VIEW, SHOWING TARGET SWUNG TO ALLOW CATHODE TO REGENERATE.

which was of course between the terminals of the circuit to which the energy was applied; in this case the ring anode and the cathode, from which vicinity X-light arose. Fig. 75 further illustrates this. Here the cathode is bifocal, the direction of the cathode stream depending upon which of two targets is made anode, X-light originating from the one which forms a terminal to the circuit. This tube was designed to throw some light on the ether disassociation theory already mentioned, and has no practical value, though one of a similar type has been recommended for stereoscopic work. The following observations show why such tubes are not of practical importance.

Though the area from which most of the X-light arises is on the anode target, it also comes from other places, wherever the impact of particles shot from the terminals is forcible enough. In tubes of the type mentioned, in addition to the strain in the ether between the terminals, there is a condition of less strain over a large area, therefore when the particles of gas amalgamated with the terminals fly off, they not only go from the front surfaces but also, in a less degree, from other parts of the metal, perpendicularly to its surface. As a result, the glass walls, particularly over a ring-shaped area surrounding the biconcave cathode, become a diffused source of X-light, while in properly designed tubes the energy is more delivered from the concave surface of the cathode. All energy otherwise used in a tube is not only wasted but injures the definition. In attempts to design tubes this point should be remembered, the cathode being so placed as to encourage the normal stream from its concave surface.

NOTE CIII—AN X-LIGHT TUBE HAVING A TARGET TO ROTATE IN TWO PLANES, AND WITH A RESERVE CATHODE.

Roentgen, who first used, in an X-light tube, Crookes's principle of a cathode stream focused on a metal target, was also the first to apply the principle to a tube for alternating currents, inventing the double focus type, which has, however, the defect of giving two sources of light, though for practical purposes this is not always a serious matter. In former notes I showed a variety free from this defect, the second light source being sent out of the field, but as tubes with three terminals are more difficult to construct I have until recently made less use of them. Moreover, I supposed my variety would be less efficient for the reason given in Note lxvi, but I afterward found that if the target was always an anode there was as much light as with Roentgen's, so I now describe one in which the target rotates in two planes, one parallel, the other perpendicular to the plane of the paper in Fig. 76. In this way the angle made by the target with the axis of the cathode stream can be changed to see which is most effective. As the target also rotates about a central axis perpendicular to the surfaces on which the cathode streams strike, fresh metal can be brought to receive these impacts when holes have been made. This

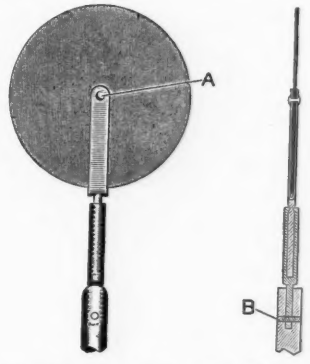


FIG. 77.—DETAILS OF TARGET. FULL SIZE.

target should always be made one terminal, the second cathode being reserved as a storehouse of gas, to be used when the resistance in the circuit between the other cathode and the target has become such that the light is not of the desired quality. As the stem of the anode is hinged, it may be dropped out of the field to allow the stream from one target to heat the other, when for this purpose they are both made terminals.

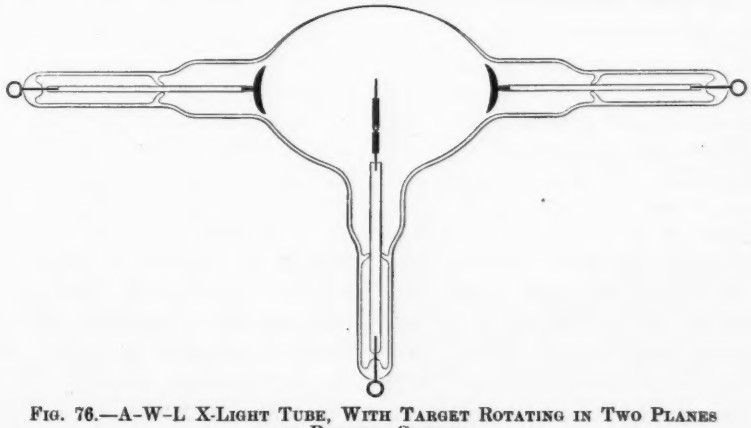


FIG. 76.—A-W-L X-LIGHT TUBE, WITH TARGET ROTATING IN TWO PLANES AND RESERVE CATHODE.

SCIENCE BREVITIES

Revolving Magnetic Flag—Under this curious name G. Jaumann describes an ingenious apparatus for demonstrating the existence of a magnetic whirl in the interior of a conductor carrying a current, says an *Electrician* abstract. The conductor in question is a beaker filled with mercury, and the indicator is a small magnet attached with one end at right angles to a glass rod running along the axis of the beaker and mounted on pivots. Thus the "magnetic flag" is capable of rotation in a plane at right angles to the direction of the current. The beaker is inserted in a tight-fitting copper vessel which furnishes the return circuit and abolishes the external field due to the current. The bottom of the beaker is perforated to admit an electrode which plunges into the mercury. To ensure that only the magnetic whirl inside the mercury influences the motion of the flag, the earth's magnetic field is compensated by suitable permanent magnets, and the glass rod or flagstaff is weighted so as to ensure neutral equilibrium even out of the vertical. When the current is turned on, the flag rotates with uniform velocity, the north-seeking pole following the lines of force. The considerable work spent in overcoming the resistance and viscosity of the mercury is taken out of the current, and shows itself in a counter electro-motive force impressed upon the circuit. This counter electro-motive force disappears as soon as the mercury has acquired the angular velocity of the flag. It reappears, but with the opposite sign, when the flag is artificially stopped, until the mercury itself has come to rest again. The flag rotates whether it is lacquered or left in the bare metallic state.

The Connection between Ether and Matter—The propagation of light across matter may be explained without supposing that the ether in the neighborhood of matter has any other properties than it has in a vacuum, is the conclusion reached by M. G. Sagnac, in a note before the Société Française de Physique. The material particles behave like small perfect conductors, each of which reflects or diffracts the electric vibrations of suitable wavelength. The author shows that, without entering upon any electromagnetic or dynamical considerations, the geometrical laws of reflection and refraction may be deduced from purely kinematical principles. The optical phenomena of the dragging of ether by matter are easily explained, without postulating a greater local density of the ether or any mechanical action between ether and matter. The kinematical theory is in agreement with the facts of dispersion and double refraction, and no difficulty is presented by the phenomena of anomalous dispersion.

Gas Currents in Incandescent Lamps—Herr J. Stark in a German contemporary, discusses the various theories advanced to account for the deposit of carbon on the inner walls of incandescent lamps in the course of time. Moissan's hypothesis of a slow evaporation of the carbon of the filament is placed in doubt by the fact that the deposit does not depend upon the degree of exhaustion. Berliner's idea that gases are occluded in the filament and escape with explosive rapidity as soon as incandescence sets in is invalidated by the observation that the deposit is the same in continuously glowing lamps and in those which are often relighted. The author attributes the disintegration of the carbon to vagrant currents between various parts of the carbon filament, which traverse the intervening gas as in a Crookes tube. These vagrant currents can be placed in evidence by probes, but they are often made evident to the eye by an "aureole" between the arms of the filament, which is nothing but the positive glow of a gaseous discharge. The internal currents are the stronger the greater the difference of potential between successive portions of the filament; *i. e.,* the higher the voltage of the circuit. The disintegration of the carbon is strongest at the cathode part, which turns rough very soon and wears through quickly where continuous currents are used.

Accumulators—A series of tests of positive and negative plates of accumulators for the purpose of ascertaining their relative capacities at different rates of discharge is described in the *Zeitschrift für Elektrotechniker,* by Herr M. U. Schoop. The method employed was to take readings at intervals between the plates and a neutral electrode of mercury — a known method — during discharge. The results are summed up as follows: (1) Negative plates are much more sensitive to excessive rates of discharge than positive (peroxide) plates of the same absolute capacity. Put in another way, this means that a given battery which will, if discharged at a slow rate, give so many ampere-hours, will, of course, when discharged at a high rate, give less; but that the difference is due to loss of capacity at the high rate on the part of the negatives—not on the part of the positives. (2) Compared with pasted negatives, Planté negatives lose their capacity in from 10 to 25 discharges. (3) In Planté positives the active material is used more effectively than in pasted positives, but the pasted positives "pick up" better on a rest. (4) In Planté batteries where negative and positive capacity is about equal, the resistance is distributed in practically the same way as in Faure batteries. (5) Generally, and more especially when the batteries are exposed to extreme loads (regulating batteries and electromobile batteries), the capacity of the negatives should be greater than that of the positives.

The Schäfer System of Wireless Telegraphy—At a recent meeting of the Physical Society of Frankfort-on-the-Main a description was given of a system of wireless telegraphy, said to be discovered by Herr Bála Schäfer. A sheet of tinfoil is pasted to a glass plate, and the foil is cut into several strips by a sharp knife. It appears that, in ordinary circumstances, there is no absolute electrical discontinuity between the first and last strips, and a resistance of 50 ohms existed in the example cited. As soon, however, as the plate was subjected to the influence of electric waves, the resistance rose to 5,000 ohms, but as soon as the waves ceased the original value of 50 ohms was resumed. Herr Schäfer has, up to the present time, been unable to find the cause of this phenomenon. He first thought it might be due to moisture on the plate, but finds that the same effect is obtained in a vacuum. In later apparatus he has replaced the tinfoil by silvered glass, the metal being divided up by several cuts, the sum of whose widths are only a few hundreths of a millimetre. The sensitiveness of the apparatus increases with the width and number of cuts up to a certain point, and then again diminishes. Either a telephone or a Morse inker can be used in the local circuit of the receiving station. It is stated, in the report of the paper published in the *Elektrotechnische Rundschau,* that experiments were made across the Bristol Channel in the presence of officers of the British Post Office, and that the British Government has decided to make use of the Schäfer system. We learn on inquiry, however, says the *Electrician,* from which this paragraph is taken, that the latter part of this statement is not correct. Successful transmission is also said to have taken place between the shore and a moving ship in the Adriatic Sea up to a distance of nearly 60 miles, a 30-centimetre induction coil and a vertical wire 20 metres high being employed.

THE PROJECTED CABLE LINE TO THE PHILIPPINES.*

BY CHANDLER HALE.

For the last 30 years Congress has, from time to time, had under consideration the establishment of a trans-Pacific submarine cable. Until recently this plan has never been more than in embryo. But with the rebirth of an isthmian Canal, as essential to communication between the East and the West, owing to the expansion of commerce, together with our recent acquisition of the Philippines, the Hawaiian group and other islands in the Pacific, the establishment of such a cable in the near future is now rendered imperative. The only questions in doubt are whether the cable should be owned by the Government or by a private company, and whether the route should be by way of Hawaii, Midway and Guam to Dingala Bay, or by Alaska, Japan, the Loo-Choo Islands and Luzon.

From a technical and engineering point of view, the practicability of a trans-Pacific submarine cable is assured, the Government survey of the route which would connect California and the Philippines, by the Hawaiian Islands, Midway and Guam, showing no obstacles which may not be avoided in laying the cable. More than 30 years ago the idea of a trans-Pacific cable was broached by Cyrus W. Field, but it came to nothing, as the need of such a cable was not then felt. Ocean cabling being in its infancy, and business with the East being at that time limited, the magnitude and cost of the enterprise, together with the grave doubt that was felt as to the probability of successfully laying the cable, frightened capital away from the enterprise. Now, however, after 34 years of experience, the practicability of deep-sea cable laying is well established.

The first Atlantic cable, laid in 1858, proved a failure, but in 1866 the attempt was again made and proved successful. Since then 16 cables have been laid across the Atlantic, four of which are now abandoned. The cable rates in 1866 were $10 per word, but this has gradually been reduced to the present rate of 25 cents.

As at present situated, the Government at Washington can communicate with Manila only in the most roundabout way, and its communications are at any point subject to foreign interference. And for this communication the Government is now paying about $400,000 annually for its own messages.

It seems assured that we are henceforth to be permanently and vitally associated with the East; and it would be foolish for us, therefore, to rest satisfied with the means of communication with that part of the world which we are now compelled to employ, when better are at hand, only waiting to be developed. An American cable, whether of Government or private ownership, is now an absolute necessity. All concessions granted by a government to foreigners involving permission to land upon its shores and do business within its domain make it a *sine qua non* that such foreigners in availing themselves of that privilege shall submit themselves to the jurisdiction of the country which grants the concession.

Take the proposed southern route from San Francisco to Manila, by way of Honolulu, Midway Island and Guam. If it should be owned by the Government, no branch line from Guam to Japan would be possible, because Japan, as a nation, would not consent to the United States, as a nation, establishing a cable on the Japanese coast. Nor would such a cable secure any of the business west of Manila. The private cable lines from that point onward could well arrange rates so as to retain all their present business, leaving for the Government line nothing but the business of the Philippines and the Hawaiian Islands, which annually would not amount to more than $150,000.

The following estimate shows that the cost of such a duplicate trans-Pacific cable system to Manila and to Japan would be at least $25,000,000:

COST.	
9 285 knots cable, including 10 per cent slack	$11,583,030
500 knots spare cable	623,750
Two cable ships ($300,000 each)	600,000
Two sets cable gear	250,000
Six stations	180,000
Duplex instruments, battery, etc.	60,000
Spare instruments	30,000
Traveling expenses, freight, etc.	100,000
Contingent fund	250,000
Duplicate cable	11,583,030
Total	$25,259,810
ANNUAL EXPENSE.	
Interest at three per cent on $25,259 810	$757,794
Maintenance and coal supply of two ships	250,000
Operating and traveling expenses	175,000
Repair and renewal fund	400.000
Total	$1,582 794

Without the branch line from Guam to Japan the cost would be about $4,000,000 less, or $21,259,810.

On this great investment the receipts of the Government would probably only amount to $550,000—that is, the saving of the $400,000 which is being paid at present in cabling to Manila, and $150,000 which is estimated to be the commercial cable business of the Philippine and Hawaiian Islands. Thus, from the above estimate of annual expenses and receipts, it will be seen that the Government deficit each year upon its line would exceed double the present cost of its communication to the East.

Hence, the branch line from Guam to Japan, which would largely increase the business of the whole line, by entering into competition with the Indian cables, is necessary from a business point of view to a profitable American line on this route. And this branch line, as already shown, could secure permission from the Japanese Government to land on Japanese territory only if it were established and conducted by private enterprise.

Having discussed the feasibility of a trans-Pacific cable owned by the Government, it is worth while to turn to the consideration of the more northern, or Alaskan, route (which has been also surveyed, though not by the Government), as compared with the southern course.

The northern cable route divides itself naturally into six links, of about 800 miles each, a fact which is of very great moment from a constructive point of view, as it would render one type of cable available for all the links, so that any link might be replaced with one reserve cable. The stations proposed on this route are: (1) Sitka, the capital of Alaska, 803 miles; (2) Kadiak Island, the farthest station north, in the latitude of Aberdeen, Scotland, 682 miles; (3) Dutch Harbor, the greatest northern port for the immense Bering Sea gold travel, 770 miles; (4) Attu, the western end of North America, 810 miles; (5) The Japanese-Russian border, 858 miles; (6) northern Japan, 810 miles, whence there are many wires overland, as well as cables to within 200 miles of the Philippines.

Primarily, a cable by way of Alaska to the Philippines, and in addition thereto a separate line from California to Hawaii, could be laid for about $12,000,000, as is indicated in the following table:

Route.	Single Miles.	Single Cost.	Duplicated. Miles.	Duplicated. Cost.
International cable, U. S. to Asia	4,883	$4,000,000	8,876	$6,000,000
Same, with cable to Hawaii	7,283	6,500,000	12,276	9,200,000
American, northern, to Philippines, *via* Alaska, with branches to Japan and separate cable to Hawaii	9,335	9,000,000	12,735	12,000,000
American, southern, *via* Hawaii and Guam	7,750	13,500,000	14,250	25,000,000

This surprising difference in cost is largely due to the difference in length of the links.

The arguments against such a route are to be found in the great natural difficulties to be encountered—fog, ice and great depths. The North Pacific is not as stormy, cold and foggy as the North Atlantic. A cable on the northern route could be repaired at any time of the year on any link, except during temporary storms, and the cable ship could always find a harbor within 100 miles of any break.

By the northern route, the different stretches vary but slightly in distance, and are all comparatively short, none exceeding 850 miles; so that, in case of a break, one cable ship, if it were found impossible to make repairs, could easily relay one entire stretch, the cost of which would not amount to more than $600,000.

Not so on the southern route, with its four great stretches of 2,286, 1,254, 2,593 and 1,496 miles. With these the cost of a break in a great depth, in case repair were possible, would probably amount to several hundred thousand dollars, with the likelihood also of a necessity for the renewal of an entire stretch, which would cost from $2,000,000 to $3,000,000.

(To be concluded.)

* Abstracted by permission from the *North American Review.*

ELECTRICAL MEASURING INSTRUMENTS.

BY J. FRANKLIN STEVENS.

(Concluded from page 18.)

In the above brief description of the most common types of indicating instruments, it may be noted that there is no one type which is universal, that is adapted for both switchboard and portable use for either direct or alternating-current measurements. While we can very readily dispense with the hot-wire and electrostatic instruments, the other four types are essential for some class of measurement, and for any particular line of measurement the most suitable system should be selected. It is possible that some day a universal system may be found, but, until that time, the user must select from existing types the one which in principle seems most applicable, not only to the character of electrical energy to be measured, but also to the conditions under which measurement must be made.

There is no one line connected with the electrical industry in which so much attention must be paid to details as in the manufacture of electrical indicating instruments. A very prominent engineer remarked to me recently that he had examined the construction and operation of a great many different types of indicating instruments, and, while a number of them bore evidence of similarity in design and construction, yet, in some cases, the manufacturer seemed to have acquired the "trick" of proportioning, manufacturing and calibrating, while others utterly lacked the "trick." As a matter of fact, it is not altogether a case of acquiring the proper "trick," but is a case of studying the theory and design of instruments for a number of years, backed by a large and varied experimental experience, which marks to-day the difference between the successful and unsuccessful instruments in the various types commercially exploited. Account must be taken of the most petty details of construction, the most careful and skilled labor must be employed in each department, and every particle of material entering into the instrument must be carefully selected and tested with reference to its particular function.

Personally, I have seen the experiment tried of taking a finished and efficient instrument and placing it in the hands of a careful and skilled mechanic for duplication; every wire and every part would be, apparently, an absolute copy of the original, and yet the results obtained would be totally different. It follows, therefore, that it is always wise in placing orders for electrical instruments to select a house who have publicly demonstrated the fact that they have learned the necessary "trick" or "tricks" of their profession.

In no line does reputation count for more than in the manufacture of indicating instruments, nor is there any line in which I have been brought in contact where it takes so long a time to establish a reputation. Further than this, there is no line in which a greater amount of patience is required by the manufacturer. The average purchaser is totally ignorant of the laws or principles embodied in the instrument he is using, and, without regard to the fact that he may have selected the wrong type for the particular class of measurement he wishes to make, unhesitatingly blames the manufacturer for not having known what he wanted, and for not having supplied him with the proper type of instrument by pure intuition.

Another obstacle which is commonly met by instrument manufacturers is the fact that for the average installation he is required to furnish instruments delivered to the switchboard contractor, who may or may not handle the instrument properly. It is true that most instruments are sealed, yet it is perfectly possible to utterly ruin the calibration of almost any type of instrument by improper handling without destroying the seal or opening the case. For instance, if a D'Arsonval instrument is laid upon the frame of an actively excited dynamo or motor, its entire calibration will be almost instantly changed, and yet no external evidence is presented to show exactly what has happened. Rough handling and an occasional fall, or improper packing for delivery to the plant, may further operate to destroy the accuracy of the calibrated instrument; yet the manufacturer is expected to provide instruments which will stand such usage, and which, after they have been installed, may be subject to the influence of such strong external fields or such high external temperature as to make their correct indications impossible; and, after all of this, must have his instruments accepted or rejected by the consulting or supervising engineer, who, on the day of the test, carefully checks them with his personal portable instruments, which are usually kept in almost ideal condition and seldom or never leave his immediate possession. Some day I trust these conditions may be modified to the extent that the engineer in charge will test and check the instruments, if he doubts the accuracy of the maker's calibration, before the instruments are shipped; or else issue instructions that the switchboard shall be drilled from template, and the instruments set in place by the engineer's own assistants. In several cases I have succeeded in having the latter course adopted, with the result of mutual satisfaction on part of the owner, engineer and ourselves.

If arrangements could be made to have all instruments installed under the supervision of the engineer in charge, it would then be quite sufficient to have the specifications state the limit of error allowed in the indications of the voltmeters and ammeters; and this information, coupled with a specification covering the style of case, character of scale, range and class of measurement to be made, would enable the manufacturer to make an intelligent tender for the instruments required in any installation.

While a high degree of accuracy is desirable in all indicating instruments, it is particularly important that the voltmeter should be right within at least one per cent, since a variation of one per cent in voltage means a corresponding variation in the candle-power of every incandescent lamp which may be in circuit. It is quite well known that the candle-power of any incandescent lamp varies directly with the voltage, the variation being approximately one candle-power for every volt increase or decrease from the normal voltage of the system.

Further than this, a variation of one per cent from normal voltage on a system carrying incandescent lamps means a variation of about 16 per cent in the life factor of the lamp and about three per cent in the watt consumption per candle-power. Errors in the indication of ammeters do not produce such serious results, yet it is desirable that they should be accurate in order to obviate the danger of overload on circuit, translating device, or generator; and in the case of test instruments, as high a degree of accuracy should be demanded as is required with the voltmeter.

While on the subject of the accuracy of indications, I would like to impress upon you the fact that, while we have three electrical units in common use, namely the volt, ohm and ampere, the ohm and the ampere are the only two fundamental units, the volt being a derived unit. The absolute ohm may be quite readily obtained, and, as you probably know, is defined by law as the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grammes in mass, of a constant cross-sectional area, and of the length of 106.3 centimetres. The ampere is likewise defined by law as the practical equivalent of the unvarying current, which, when passed through a solution of nitrate of silver in water in accordance with standard specifications, deposits silver at the rate of .000118 gramme per second. The volt is defined as the electro-motive force necessary to send one ampere through one ohm. This, as you will note, gives us fundamental values for the ohm and ampere and defines the volt as a derived unit, and I am laying stress on the matter for the reason that the average electrical writer defines the volt as a fundamental unit equivalent to 0000 of the po-

tential at the terminals of a standard Clark cell, and then defines the ampere as that current which one volt will cause to flow through a resistance of one ohm. As a matter of fact, the Clark cell is a secondary standard, exceedingly useful in practice, but not designed for use as a fundamental standard, due to the fact that Clark cells will vary among themselves and will give a gradually decreasing voltage at their terminals after they have been in service any length of time. It is, further, impossible to take one ampere from a single Clark cell without permanently ruining it; and, as a matter of fact, the potential of a Clark cell is only correct when the cell is used on open circuit.

It has been rather difficult for me to understand why the absolute ampere has been so little used or so seldom referred to, when it is a unit more readily verified than is possible with the volt. It is true that the fundamental method of determining the ampere is rather slow and tedious, but it is extremely easy to obtain the absolute ampere in centimetre-gramme-second units by the use of the tangent galvanometer. Defined in centimetre-gramme-second units the ampere is such a current that, passed through a conducting wire bent into a circle of the radius of one centimetre, will attract a unit magnetic pole held at its centre with a force of one dyne; and this method applied to the tangent galvanometer gives the very simple formula of current equals galvanometer constant into the tangent of the angle of deflection of the polarized needle, the galvanometer constant being readily determined from its dimensions and the number of turns of wire, in connection with a determination of the value of the horizontal component of the earth's magnetism. Having once determined the absolute centimetre-gramme-second value of the ampere, we know that the practical ampere is one-tenth the value of the centimetre-gramme-second unit. Having obtained the absolute standards of current expressed in amperes, and resistance, expressed in ohms, the standard volt is readily determined from the relations given in Ohm's law. With the primary units once determined, all others, such as the farad or coulomb, can be readily obtained.

To obtain absolutely correct standards of voltage and current for alternating-current calibration, it is only necessary to calibrate a dynamometer voltmeter and a dynamometer ammeter in true volts and amperes, as determined by fundamental standards; then, as a dynamometer measures directly the square root of the mean square, it will indicate correctly the virtual voltage or current in an alternating circuit. In calculating resistance in alternating-current instruments, it is necessary to modify Ohm's law to the extent of substituting impedance for resistance. Since impedance is the vector sum of the ohmic and inductive resistances, it is readily obtained by triangulation when the two resistances are known, or when one is known and the angle of lag can be ascertained.

While the design, workmanship and material entering into the construction of an instrument are of vital and fundamental importance, the actual calibration is equally important. Assuming the manufacturer has reliable standards of voltage, current and resistance, trained observers are necessary who should be instructed not only to properly mark the scale, but to check it; and should also be instructed to carefully test the instrument for errors due to reversal, to lag or hysteresis, and for errors introduced by the presence of external fields, or by the variations of internal or external temperature. Certain definite limits must be set for errors allowed, and no instrument permitted to go out until it has fully come up to the standard so set. In the company with which I am associated, we not only make all of these tests and check readings, but, likewise, provide an additional check on the calibration by plotting the calibration curve at the time the scale is made by the draughtsman, and if errors or irregularities are observed in the curve showing a departure from the standard curve applicable to the type of instrument under construction, the instrument is promptly returned to the calibrating room to have its readings checked, or to hunt for and remove the defect which caused the irregularity. It is a known fact that for every type of system there is a characteristic scale, following a more on less complex law, and any variation of the calibration from the normal indicates immediately that there is something wrong, either in the construction of the instrument or of some of the elements entering into it; or else it was inaccurately calibrated. I, personally, attribute a great deal of our commercial success to this intermediate checking in the drawing room, and you can put it down as a settled fact that any manufacturer who produces instruments of any particular type, the scales of which for corresponding ranges vary greatly from one another has not yet mastered the proper design or construction of his instruments.

It would be impossible to detail the many different kinds of measurements which can be made with the proper type of voltmeter, ammeter and wattmeter. In general, however, the possession of these three instruments enables one to measure not only voltage, current and power, but, likewise, capacity, inductance and resistance; and from these various measurements may be obtained data covering the performances of almost any type of generating or translating device.

There are many special forms of indicating instruments designed to indicate directly some of the various measurements most frequently employed, two of which, at least, are so universally used at the present time that they deserve, at least, passing mention. One is a voltmeter designed for use on constant-current arc light circuits, capable of indicating directly the total electro-motive force of the dynamo, and so connected by means of self-contained switches that not only can the total voltage of the dynamo or circuit be read, but, likewise, the presence of a ground indicated and its actual value in volts directly determined. This involves an arrangement of connections so that the voltmeter can be connected directly across the terminals of the circuit and then connected successively from the plus and minus side of line to ground. From the three readings thus obtained the number of lamps burning can be directly ascertained, the presence of the ground shown and the ground itself can be absolutely located by a very simple calculation. By employing, in addition to this, the known resistance of the instrument, the actual resistance of the ground in ohms may be obtained, thus defining its character.

An instrument of this character was brought out by my company some few years ago, and has met with almost universal favor, due largely to the growing tendency to measure resistances under full working potential. Such an instrument will show grounds which would not be shown by the ordinary galvanometer and bridge method of testing, and further enables the switchboard attendant to locate grounds while the line is in operative condition.

Another instrument which, for a time, fell into disuse, but which to-day is being used more extensively than ever, is the differential voltmeter, designed primarily to show the difference in potential between the bus-bars and any dynamo which has to be connected to the bus-bars in parallel with dynamos already operating. It is rather a curious fact that the average dynamo tender places implicit confidence in the indications of his differential voltmeter. The mere fact that he can see the pointer come back to zero when the free dynamo is being brought up to voltage, and the knowledge that when the pointer does stand at zero he can throw the free dynamo into circuit without danger of trouble, impresses him with the idea that the instrument is essentially reliable and accurate, and he is ready to condemn any or all of his regular switchboard voltmeters which fail to agree with it in indication. This tendency has led my company to devote special attention to the calibration of differential voltmeters and to furnish them with a full scale which indicates the exact voltage of the bus-bars, in place of furnishing instruments which give full scale deflections for 10 per cent or 20 per cent of the normal voltage.

In closing, I would say that I know of no subject connected with electrical engineering which promises such rich rewards for investigation as the subject of electrical measuring instruments, and if my hasty and very general review of the subject will influence any one to pursue the subject thoroughly and scientifically, I shall feel more than repaid. I have confined practically my entire time and attention to this line for a number of years and find the subject grows more interesting the further I investigate it, and I hope the time is not far distant when the literature on this subject will be as complete and as comprehensive as that now available in allied branches of electrical engineering.

A Frictionless Electric Meter.

In a paper recently read before the (British) Institution of Electrical Engineers, Mr. Sidney Evershed described a beautifully ingenious form of integrating motor meter, from which friction has been practically eliminated.

The essential working parts of the meter are shown in Fig. 1. The armature A, brake dish F, and train-driving coils D_1 D_2, are mounted on a mild steel axle *a*. The axle has a hard steel point at its lower end, resting in a jewel cup, J; its upper end has no mechanical support, but is maintained in position by the magnetic attraction of an iron rod R, which is magnetized by the brake magnets M M through and iron yoke Y, and forms the supporting pole. The distance between R and the end of the axle is adjusted by screwing R in the yoke Y until the vertical force nearly suffices to lift the whole weight of the armature, brake and other parts attached to the axle. The arrangement is more clearly seen in Fig. 2, which is a section through the magnetic pivot. A magnetic pivot of this type may easily be made to support a weight of from 100 to 200 grammes.

The commutator K is placed beneath the armature, and the wheel brushes *b b* are pivoted in frames attached to an ebonite plate E. The commutator and brushes are shown on an enlarged scale in Fig. 3. The segments are fine iridio-platinum wires supported at one end in an ivory collet and entirely free at the other end, where they impinge and roll on the brush wheels. The commutator is about three millimetres in diameter at the rolling circle; the wheels are about 36 millimetres diameter, so that they make one revolution to 12 revolutions of the commutator.

The pressure current is led to the brush wheels through their frames, and to insure good contact between frame and wheel, the step bearing of each wheel is an iridio-platinum pivot resting on a flat plate of the same metal.

A drum-winding is used for the armature, a break being made, in the ordinary course of winding, in each parallel, in order to insert the two little coils D_1 D_2. Thus D_1 is in series with one of the two parallels of the drum-winding, and D_2 in series with the other; they are consequently each traversed by one-half of the whole armature current, and since they are, electrically, a part of the armature circuit, the current in them is reversed twice in each revolution of the axle. D_1 and D_2 are inserted at corresponding points of the drum-winding, so that their currents reverse at the same instant, and they are coupled up so that the two currents flow in the same direction and to all intents and purposes D_1 and D_2 behave like one coil.

Fig. 4 shows the connections of the train-driving coils in diagrammatic form,

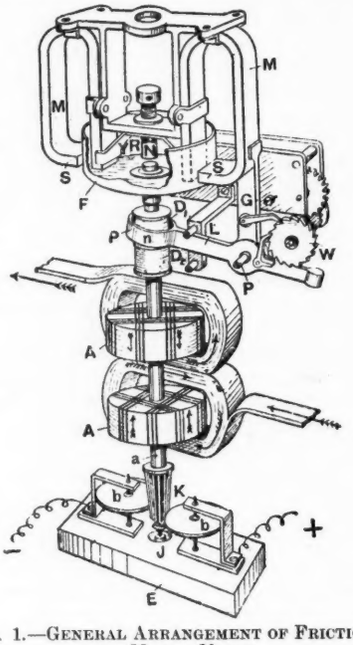
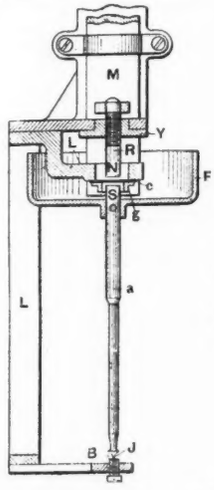


FIG. 1.—GENERAL ARRANGEMENT OF FRICTIONLESS MOTOR METER.

a Gramme winding being substituted for the drum for the sake of clearness. Surrounding the train coils D_1 and D_2, but not touching them, is a ring of soft iron P (Fig. 1), forming part of an iron lever L, mounted on a horizontal axle *p*. L is



M. Brake magnet; *Y*, iron yoke between the brake magnets.
R. Iron rod forming supporting pole *N*.
a. Iron axle having upper end *S* beneath pole *N*.
c. End-plate (non-magnetic).
g. Guard ring to prevent axle from being displaced.
F. Brake dish.
B. Step bearing with jewel cup *J*.
L. Axle bearing frame.

FIG. 2.—AXIAL SECTION SHOWING DETAILS OF MAGNETIC SUSPENSION IN A FRICTIONLESS METER.

magnetized by induction from one of the brake magnets, an iron bar G serving to complete the magnetic circuit between S and *n*. The induction leaves the ring pole P, and passes radially through the train coils into the axle, and P consequently experiences a vertical force alternately upwards and downwards as the currents in the train coils periodically reverse. The result is that L oscillates on its axis, making a double stroke or complete cycle once in every revolution of the armature. The motion of the lever is limited by stops, and is communicated by means of a pawl, to a ratchet wheel W, which is attached to the first axle of the counting-train T.

It will be seen at once that this device opposes no retarding moment on the armature axle. The only mechanical force called into play is in a vertical direction, and has no component tending to turn the axle. The train coils and magnetized lever form a reciprocating electric motor, and, during the time the ring pole is moving up (or down) there is a back electro-motive force in the train coils, and the product of this back electro-motive force into the armature current and the time gives the consumption of electrical energy per stroke. It is, of course, equal to the mechanical work done—product of force on P into length of stroke. The force actually provided is far greater than that necessary to drive the train. The friction of an ordinary train is just overcome by a turning moment of about four dyne centimetres applied to the worm or pinion commonly used on a meter axle to gear into the first wheel of the train; six dyne centimetres will generally keep a train running at a speed a good deal higher than anything save a short circuit can produce. The author has tested many trains taken out of different electric meters, and curiously enough they differ very little as regards friction.

Now, if the train were geared to the axle in the usual manner, and required a moment of six dyne centimetres to keep it going, the work done by the meter in driving the train, being, of course, 2π times this moment in each revolution, would be about 38 ergs. The stroke of the train-driving lever is about 1.0 centimetre, so that the force upon it must be at least $\frac{38}{1.0}$ = 38 dynes. The force actually obtained is about 750 dynes, which leaves an ample margin for accidental friction. It is assumed that the lever does no useful work on its return stroke.

A number of different forms of this train driver have been designed, and several of them have been tested in actual work. Fig. 5 shows a modification characterized by the same fundamental principle, namely, a coil producing an alternately upward and downward force upon the free end of a lever. In this modifi-

cation the two train coils D_1 and D_2 are coupled back to back, so that they produce a consequent pole in the space between them, and the movable coil attached to the end of the lever is alternately forced up and down. This coil forms part of the series resistance in the armature circuit, and carries the whole of the pressure current. Fig. 5 is intended for alternate current meters, where a permanently magnetized lever would, of course, be useless.

There are other features in the design

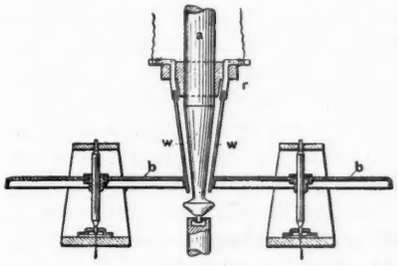


FIG. 3.—ELASTIC COMMUTATOR AND REVOLVING BRUSH WHEEL.

of the meter which will be of interest to station engineers, but which are hardly of sufficient general interest to warrant such a detailed description as has been given of the means adopted to reduce friction. The whole of the working parts of the meter, with the exception of the main current coils, are attached to a light framework, which is bolted to the top of the casting which forms the back, top and bottom of the meter case. The other three sides of the case are formed by a bent sheet of zinc, which is screwed and sealed to the casting. The terminals project below the bottom and are covered by an insulating box, which may be sealed after connecting up on the consumers' premises. The Foucault brake is in the form of a shallow dish, and the two brake magnets are fixed in positions which make it impossible for any excess of current in the main coils to demagnetize them. Their stray field is at right angles to that of the main coils.

Brooklyn Rapid Transit Conspirators Sentenced.

The jury in the conspiracy trial of the Brooklyn Rapid Transit Company, at New York, on July 2, returned verdicts of guilty against Goslin, Parker and Davis. Bogert was found not guilty in accordance with the instruction of the court. The defendants were accused of publishing statements to depress Brooklyn Rapid Transit stock on the exchanges in New York and elsewhere.

WHY SOME MUNICIPAL ELECTRIC PLANTS DO NOT PAY BETTER.*

BY GEO. D. SHEPARDSON.

Municipal ownership of electric light plants has been the nightmare of many a station manager and also of many a taxpayer, according as the standpoint is before or after taking. The reasons for and against municipal ownership have discussed *ad nauseam* and yet the agitation continues. This subject, like many another, exemplifies the old adage: "A man, convinced against his will, is of the same opinion still." He who begins with a belief in the desirability of municipal ownership finds plenty of argument to bolster his faith, while he who believes in private ownership finds other arguments equally convincing, at least to himself and his sympathizers. It is doubtless true that each side has an element of truth and also that neither is entirely correct in every particular. Local conditions are the determining factor in many cases. Considered as an entirely abstract question, it is a difficult matter to decide what public utilities should be owned by the municipality, what should be owned and managed by private enterprise, and to what extent the municipality should control the latter. It is largely a matter of degree, rather than of abstract right or wrong, in the essence. With the above in mind, the writer has no idea that this paper will convince anyone either of the desirability or the undesirability of public ownership in his own locality. The only aim is to present certain phases of the subject that may not have received sufficient recognition, and to see how both sides appear.

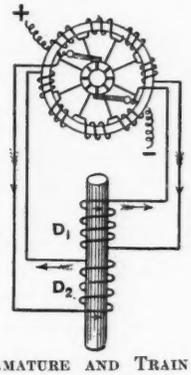


FIG. 4.—ARMATURE AND TRAIN COIL CONNECTIONS.

The subject of municipal ownership has been discussed at almost every session of this association, and the general sentiment seems to be that the principal cause of the agitation in favor of municipal ownership is the circulation of incorrect figures as to the real cost of operating existing municipal plants. It is easy to see why the reports of such cost are almost invariably too low. The towns almost never know the real cost of the lights, on account of faulty records. Each town desires to make the best showing possible, for when a low figure is quoted, the general public immediately conclude that they are enterprising people, while those who know how such reports are compiled smile at their ignorance of the real cost. The other principal cause is the general belief on the part of the public that the electric companies are making enormous profits, whereas the painful fact is that probably few of the smaller companies, at least, are really earning any dividends. In towns of less than 2,000 or 3,000 inhabitants, it is a very difficult matter for an electric light station to earn respectable dividends unless it is operated in conjunction with some other business, for example, a mill, so that the labor and administrative expenses are reduced to a minimum. Similar conditions hold in many plants in larger towns. The reports of some stations show larger profits than actually exist, which, while flattering to stockholders, are yet deceptive if not positively harmful. A uniform method of keeping accounts, such as is being urged by the National Electric Light Association, would do much to help station managers discover their own real situation. Did the municipal and private plants have correct methods of keeping records, so that it was generally known how much it actually costs to operate municipal plants and how small the net earnings of private plants really are, the agitation would probably die a natural death in a few years. As a matter of fact, the managers of some of the largest central stations advocate the public supervision of their account that the actual facts may be in the possession of the people. The ordinary citizen reads the report that the operating expenses of a large plant are only 50 per cent of the gross income, and he believes that the remaining 50 per cent is clear profit, forgetting about the numerous charges which reduce this to 15 or 5 per cent. He also compares the cost of a kilowatt-hour produced at the station with that charged on his bill for service, and then firmly believes that the company is making from 100 to 2,000 per cent clear profit. The public generally have no objection if a reasonable dividend is earned, but there is objection to what are felt to be enormous profits.

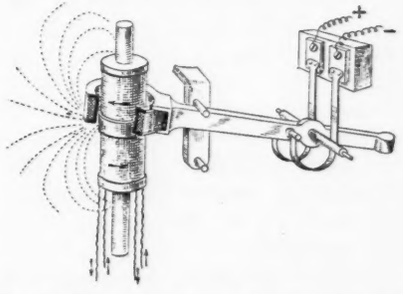


FIG. 5.—LEVER FOR ALTERNATING CURRENTS.

(To be concluded.)

* A paper before the Northwestern Electrical Association, Waupaca, Wis., June 26 to 28, 1900.

The Twentieth Anniversary of the Edison Incandescent Lamp.

Twenty years ago, Mr. Edison after two years of experimental work gave the first public exhibition of his incandescent lamp in his laboratory at Menlo Park, and early in 1880 started the first Edison lamp factory. It is an interesting fact that the lamp to-day contains the same elements that it contained 20 years ago, none having been added and none omitted from the lamp during this period of time, and yet each of the elements which constitute the lamp has been so changed and developed that the lamp to-day is different in every respect from the old lamp, both in appearance and performance, and also in economical construction. This last item is well illustrated by the fact that 20 years ago lamps sold at $1.00 in the same quantities for which they now sell at 20 cents, and the profit per lamp is very much more now than it was then; in fact, it is believed that lamps sold at $1.00, 20 years ago, were sold at a loss.

The lamp bulbs of 20 years ago were made at the lamp factory from glass tubing, being blown by eye without any other guide, so that their shape could not possibly be more uniform than the skill of various operators could make them. The bulbs are now blown in a mould at the glass works, insuring uniformity of shape and size.

The filament of the lamp has changed very materially, both in appearance and in character. It was then made of bamboo, cut to the desired size by plane. This planing required eight different operations before the piece was reduced to the desired size. This was not only expensive, requiring very accurately made tools, but even at best it was very difficult to make a filament which was as uniform in size as the requirements of the lamp demanded.

The old bamboo filaments were put into the lamps just as they came from the carbonizing furnace, so that the performance of the lamp was limited by the temperature which this piece of wood charcoal would stand. This temperature was nothing like as high as is possible with the present filament, which has the graphite coating that is now added to the filament after it comes from the furnace.

The efficiency of the lamp, which is ordinarily expressed in watts per candle, is determined by this temperature, and the difference between the old and the new may be well illustrated by the figures of 6 watts per candle-power in the lamps of 20 years ago, and 3.1 watts per candle-power at the present time.

This difference in efficiency does not tell the whole story, because the filament of 20 years ago, was a plain loop, which, although it gave 16 candle-power in the position in which lamps are measured, yet the total light given by a 16-candle-power lamp then was much less than that given by a 16-candle-power lamp now, because the present filament, being of the well-known oval form, gives a much larger light in the positions other than the one in which lamps are measured than did the old one; thus the old loop measured through the tip of the lamp, only gave three candles, whereas the present lamp in that position gives seven candles.

The glass tube which supports the filament from the bottom of the lamp has been developed very considerably, although in appearance it is much the same. The tendency of the change has been to reduce the necessary amount of platinum used in the old lamp. In the old lamps probably 10 times as much platinum per lamp was used as is used to-day, and yet the platinum of to-day does its work just as well as it did in the old lamps with the larger amount used.

The base of the lamp has been improved, not only in appearance, but also in performance, as the old bases were constructed on a bad principle which caused many of them to break in use.

The last, but one of the most important elements in the lamp, which, although important is invisible, is the vacuum. Vacuums were produced 20 years ago as good as can be produced to-day, but great improvement has been made in the methods of getting it, and in the uniformity with which it is made. Twenty years ago it took five or six hours to exhaust a lamp, whereas now they are exhausted in one minute, while the proportion of inferior vacuums produced 20 years ago was very much greater than it is to-day.

The improvement in methods of manufacture, which is illustrated by the great reduction in cost mentioned before, may be further illustrated by the fact that only a few years ago the cost per lamp produced of the breakage incurred in the manufacture was greater than the total cost of the lamps at the present day.

Another element in the lamp, the changes in which have been plainly evident to the eye, is the joint between the filament and the platinum leading-in wire. In Edison's early lamps this joint was made by means of a small screw clamp, the filament being squeezed into the jaws of this by a screwdriver, which was a very expensive method.

This was followed by a copper-plated joint, the leading-in wire being folded around the end of the filament, and the whole joint being covered by copper by electro-deposit.

Both these methods required that the ends of the filament be enlarged so as to cell the filament before it came in contact with the metal. This required greater accuracy in the cutting of the filament, as, being made with enlarged ends, there was no possible variation in length after it was carbonized, and if it was made wrong originally it could not be changed.

The present filaments are made longer than they are needed and cut to the right length after they are carbonized. This is made possible by means of a carbon joint between the filament and wire, which is not injured by the high temperature at the point where the filament leaves the joint.

This carbon joint was first made by folding the leading-in wire around the filament and heating the joint so made very hot under gasoline. The heat decomposed the gasoline and deposited a carbon covering on the joint which made a very perfect connection.

This was superseded by the present carbon joint which is applied in the form of a carbon paste, which, after being baked in a furnace (which decomposes the hydrocarbon liquid element of the paste) forms a dry carbon joint which is quite satisfactory.

A very great deal of work has been done in the development of each of the elements of the incandescent lamp, and the development of each must be done with a knowledge and consideration of all the other elements, as a change in one element may be very good considering that element alone, but may affect the others disadvantageously.

This makes a problem with several factors in it, all of which are very important, and the effect of a change in one is often very difficult to trace to the element which has caused it, as the effect often appears as far distant from the cause as is possible.

The success of the Edison lamp has been very materially aided by the system of inspection employed at the factory and by the very accurate selection of lamps, so that each lamp is shipped for use at the voltage for which it is best adapted. A lamp used on its proper circuit will give a satisfactory result, whereas the same lamp on a wrong circuit will perform very badly.

It is endeavored that all lamps be shipped for use on a proper circuit, and this is only possible where the lamps pro-

duced by the factory are such as will fit the circuits for which it has orders.

To accomplish this result, very careful attention must be given to the processes in the factory which determine the voltage and candle-power of a lamp when finished. There are used in the factory pieces of apparatus which measure the diameter of the filaments to the one-forty-thousandth of an inch. Enough of these instruments to do all of the work are in constant daily use in the factory, handled by regular employees, so that it is a commercial machine and not a mere laboratory tool.

The other essential measurements of the filament, which is the determining factor of the candle-power and voltage of the lamp, are also done with great accuracy, and the result is the manufacture of useful lamps only, so that there is no temptation to ship lamps wrongly assorted in order to get rid of undesirable stock.

The system of inspections which cause the rejection of lamps for faults which would not have received consideration a few years ago is a considerable expense to the factory as apparently good lamps, and, frequently, good lamps, are rejected and made up to standard or else broken up.

While the immediate effect of such inspections and rejections is to increase the expenses, the ultimate effect is to increase the business on account of the greater excellence of the lamps which are shipped. The result of this policy is shown in the very large increase in business during recent years.

The Edison Lamp Factory of the General Electric Company, turns out 55,000 lamps per day or nearly 16,000,000 lamps per annum.

Merchants and Manufacturers' 20th Century Exposition.

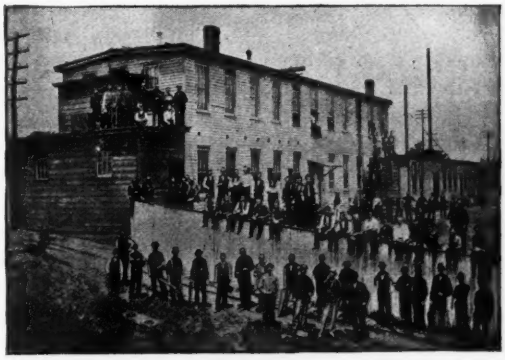
At the Mechanics' Building, Boston, from October 1 to October 27, of the present year, there will be held the first triennial show under the auspices of the Merchants and Manufacturers' Association (Incorporated). Its design is to make the dawn of the twentieth century a memorable occasion in New England, and unlike most trade expositions this one will be thrown open to all products known to civilization. There are six acres of floor space in the Mechanics' Building available for exhibits. Mr. Frank Ferdinand, of Boston, is president and treasurer of the association which will hold the exposition. He will be glad to furnish all particulars on request.

ELECTRIC LIGHTING

The Snoqualmie Electric Light Company, of Spokane, Wash., has been granted a franchise to operate in Snohomish County.

An entire new equipment has been purchased for the electric light system to be established at Centreville, Minn., by G. Norgen, a local capitalist.

The Nanticoke, Pa., Electric Light, Heat and Power Company, at the annual meeting, elected the following directors: M. W. Morris, C. E. Stegmaier, Sol Hirsch, Dr. J. A. Bullard, Simon Wormser, W. D. Beers, E. W. Mulligan. At a meeting of the directors the following officers were elected: President, C. E. Stegmaier; vice-president, Dr. J. A. Bullard; treasurer, George W. Beers; secretary, W. D. Beers.



THE EDISON ELECTRIC LAMP FACTORY AT MENLO PARK, N. J., IN 1880.

It has been announced that the Blue Lake Transmission Company within a month will be able to furnish power to the city of Oakland, Cal., as it is already furnishing it to San José, San Mateo, Alameda and Stockton. It is said that San Francisco will soon be reached by this company, which uses 60,000 volts pressure on its 145 miles of line.

The entire assets, including real estate and plant, of the Detroit Electric Light and Power Company, which have been in the hands of N. G. Williams, as receiver, were sold, on June 29, by the United States Court, under mortgage foreclosure proceedings, for the sum of $165,500. It is understood that the purchaser has made arrangements for the sale of this property to a company composed of the shareholders of the Edison Illuminating Company, of Detroit.

The necessary papers for the incorporation of the Dutchess Light, Heat and Power Company have been filed. The capital stock is placed at $20,000, and the main office of the company is to be located at Rhinebeck Village, N. Y. The directors for the first year are: George N. Miller, Thaddeus A. Traver, Frank Herrick, R. Raymond Rikert, M. V. B. Schryver, all of Rhinebeck. The territory in which the company will begin its operations is in the neighborhood of Rhinebeck and Red Hook.

The Yates Electric Light and Power Company has been incorporated with a capital stock of $300,000; number of shares, 3,000. The objects of the company are to be manufacturing, using and supplying electricity for producing light, heat or power, and lighting streets, avenues, public parks and places, and public and private buildings in the village of Penn Yan and towns of Jerusalem, Milo and Benton, in New York state. The directors are: Henry B. Pierce, Walter Cox, Henry T. Howell, Frederick P. Delafield and Frederick W. Longfellow, New York city, and Cassius L. Haskell, West Brighton, N. Y.

The Central Electric Company, recently organized to unite the electric light companies of central New Jersey under one management, has absorbed the electric light companies of New Brunswick, Perth Amboy, Rahway, Metuchen and Bound Brook. All these companies will henceforth be operated by the Central Electric Company, which has a capital stock of $100,000, and these officers: President, Philip N. Jackson; vice-president, Adrian Riker; treasurer, Uzal McCarthy. Among those interested in the new union, besides the gentlemen already mentioned, are: Durley Farrand, L. D. Howard Gilmore and Counselor Spencer Weart.

The Edison Electric Illuminating Company, of Long Island City, N. Y., with a capital stock of $500,000 and a bonded indebtedness for the same amount, and the Jamaica Electric Lighting Company, capital stock, $200,000, with a bonded indebtedness of half that sum, have been purchased by Wilson & Stephens, of Manhattan. The purchase was made in the interests of the New York & Queens Gas and Electric Company, which has a capital stock of $1,000,000 and a bonded indebtedness of $950,000. This concern operates in Flushing, College Point and Whitestone. The outstanding company operates in Rockaway. If the plans of the new corporation are carried out, it will soon control all the lighting interests in the borough of Queens, New York city.

The American Bridge Company.

The American Bridge Company has issued the following circular letter to the trade:

"As a result of numerous conferences it has been deemed expedient to organize the American Bridge Company, incorporated for the purpose of designing, building and erecting bridges and all classes of metallic structures. The facilities at our disposal are such that we have every confidence that we shall be able to give you the advantage of very favorable quotations and at the same time be enabled to avoid delays in delivery which in the past have proved so vexatious in many instances. We solicit your inquiries which shall have our very best attention."

Accompanying this is a list of the various bridge companies forming the consolidation, as follows:

American Bridge Works, Chicago, Ill.
Berlin Iron Bridge Company, East Berlin, Ct.
Buffalo Bridge and Iron Works, Buffalo, N. Y.
Carnegie Steel Company (Keystone Plant), Pittsburgh, Pa.
Edge Moor Bridge Works, Wilmington, Del.
Elmira Bridge Company, Elmira, N. Y.
Gillette-Herzog Manufacturing Company, Minneapolis, Minn.
Groton Bridge and Manufacturing Company, Groton, N. Y.
Hilton Bridge Construction Company, Albany, N. Y.
Horseheads Bridge Company, Horseheads, N. Y.
Lafayette Bridge Company, Lafayette, Ind.
Lassig Bridge and Iron Works, Chicago, Ill.
N. J. Steel and Iron Company, Trenton, N. J.
New Columbus Bridge Company, Columbus, Ohio.
Pittsburgh Bridge Company, Pittsburgh, Pa.
A. & P. Roberts Company (Pencoyd Iron Works), Pencoyd, Pa.
Post & McCord, Brooklyn, N. Y.
Rochester Bridge and Iron Works, Rochester, N. Y.
Schultz Bridge and Iron Works, Pittsburgh, Pa.
Shiffler Bridge and Iron Company, Pittsburgh, Pa.
Union Bridge Company, Athens, Pa.
Milwaukee Bridge Company, Milwaukee, Wis.
Wrought Iron Bridge Company, Canton, Ohio.
Youngstown Bridge Company, Youngstown, Ohio.

This list contains all the leading companies that manufacture bridge and structural work in this country, with the combined capacity of 600,000 tons per annum. The Pencoyd plant, of the A. & P. Roberts Company, also comprises one of the best and most complete rolling mills for structural material in existence, with a capacity of 200,000 tons per annum. This puts the American Bridge Company in a position to furnish all classes of bridge and structural work at an absolute minimum of cost, and in the very shortest possible time, and this has already been announced as the future policy of the company. No advance in prices will be made, but the cost of production will be reduced to an absolute minimum, and judging from the known facilities of the various plants, the facts would seem to justify the statement. The directors of the company are as follows:

Percival Roberts, Jr., A. & P. Roberts Company (Pencoyd Iron Works), Pencoyd, Pa.

Alfred C. Case, Carnegie Steel Company, Pittsburgh, Pa.

William H. McCord, Post & McCord, Brooklyn, N. Y.

Charles M. Jarvis, Berlin Iron Bridge Company, East Berlin, Ct.

William H. Connell, Edge Moor Bridge Works, Wilmington, Del.

Walter Hawxhurst, Elmira Bridge Company, Elmira, N. Y.

Charles Macdonald, Union Bridge Company, Athens, Pa.

Frank Conger, Groton Bridge Company, Groton, N. Y.

James P. Kennedy, Youngstown Bridge Company, Youngstown, Ohio.

Lewis S. Gillette, Gillette-Herzog Manufacturing Company, Minneapolis, Minn.

John F. Alden, Rochester Bridge and Iron Works, Rochester, N. Y.

Walter G. Oakman, Guarantee Trust Company, New York, N. Y.

J. P. Ord, General Electric Company, Schenectady, N. Y.

Robert Winsor, Kidder, Peabody & Company, Boston, Mass.

Robert Bacon, J. P. Morgan & Company, New York, N. Y.

Charles Steele, J. P. Morgan & Company, New York, N. Y.

Paul E. De Fere, 40 Wall street, New York, N. Y.

Robert S. Green, 1 Montgomery street, Jersey City, N. J.

J. W. Walker, Shiffler Bridge Company, Pittsburgh, Pa.

Abram S. Hewitt, Cooper, Hewitt & Company, New York, N. Y.

August Belmont, August Belmont & Company, New York, N. Y.

The majority of this board are practical bridge men who have in years past made a success of their individual companies. The financial end is unusually strong, being represented by firms and institutions of world-wide financial strength, thus forming a combination of practical and successful bridge men, backed by the strongest of financial resources.

The executive organization is made up entirely of men of large practical experience, headed by Percival Roberts, Jr., one of the leading rolling mill managers of the country. The Pencoyd plant of the A. & P. Roberts Company, comprising a rolling mill with a capacity of 200,000 tons per annum and the most complete bridge and structural plant in the world, has all been developed under his personal supervision, and is the result of his energy and ability, eminently fitting him to head an enterprise of this kind.

Joshua A. Hatfield has been appointed as assistant to the president, and will also have charge of the sales of the rolling mill products of the Pencoyd plant, a position which his long and favorable connection with the sales department of the rolling mill interests of the country makes him especially adapted. The engineering department is in charge of Mr. Charles C. Schneider, formerly chief engineer of the Pencoyd Iron Works, of the A. & P. Roberts Company, with the title of vice-president, in charge of engineering. Mr. Schneider has full charge of all questions of engineering, including the preparation of all plans, estimates and working drawings, and all engineers of the company, whether engaged in the contracting, operating or erecting departments, are under the vice-president in charge of engineering. At different localities throughout the country are stationed a corps of designing engineers to prepare preliminary plans and estimates, and at each plant will be located a full and complete corps of engineers and draughtsmen to prepare plans for the work fabricated at that particular plant.

The operating department is in charge of Mr. Charles M. Jarvis, formerly president of the Berlin Iron Bridge Company, with the title of vice-president, in charge of operating. As soon as contracts for any work are taken, they are immediately turned over to this department for execution, and consequently all the plants and erecting forces of the company belong in this department. At each plant is a manager, with full charge over all employees and the operation of that particular plant. Where a number of plants are closely located, they are placed under one local manager, each plant being equipped with a superintendent. All managers are under the direct charge of a general manager, Mr. James P. Kennedy, formerly president of the Youngstown Bridge Company, who moves about among the various plants in order to see that all are work-

ing in one harmonious whole, and that each has the advantage of the experience of every other plant. The erecting is also in charge of the operating department, and this is under Mr. William Wennas, as superintendent. Mr. Wennas has had full charge of all the Pencoyd erecting for a number of years, and gained a world-wide reputation but a short time ago for the economical and expeditious manner in which he handled the erection of the famous Atbara Bridge.

All the sales of the company are in charge of the contracting department. This is divided into three distinct parts; railway contracting, highway contracting, structural contracting.

The railway contracting is in charge of Mr. Charles Macdonald, formerly president of the Union Bridge Company. The highway contracting is in charge of Mr. Frank Conger, formerly president of the Groton Bridge and Manufacturing Company, and the structural contracting is in charge of Mr. W. H. McCord, formerly of the Post & McCord Company. The preparation of all proposals and contracts is in charge of this department. The company has opened contracting offices in different parts of the country, each office reporting daily by wire to various members of the contracting department. The contracting department of the American Bridge Company is one of the most important, as here are made up the proposals and estimates on all work, and it might almost be said that on the careful judgment and management of the members of this department depends chiefly the success of the company.

The mechanical department has been made of equal importance with all other departments, and has been placed in charge of Mr. James Christie, formerly mechanical engineer of the Pencoyd plant, with the title of vice-president. The mechanical details of all the various plants belong to this department, and the selection of Mr. Christie as the head insures the American Bridge Company a mechanical equipment that will guarantee the production of a pound of finished bridge material at the absolute minimum expenditure of power.

The financial department is in charge of Mr. William H. Connell, formerly president of the Edge Moor Bridge Works, as treasurer, with F. M. Wyant, formerly general manager of the Wrought Iron Bridge Company, and F. H. Schmidt, formerly secretary and treasurer of the Youngstown Bridge Company, as assistant treasurers. The auditor of the American Bridge Company is Mr. Charles C. Price, formerly with the Pencoyd Iron Works, of the A. & P. Roberts Company. The purchasing department is in charge of Mr. Francis W. Heisler, formerly purchasing agent for the Edge Moor Bridge Works, with headquarters at 259 South Fourth street, Philadelphia, Pa. The assistant purchasing agent is Mr. E. A. Muench, formerly purchasing agent for the A. & P. Roberts Company. The secretary of the company is Mr. Douglas O. Morgan, formerly a member of the law firm of Seward, Guthrie & Steele.

On Automobile Design.

To the Editor of Electrical Review:

I was interested in reading the editorial in your issue of June 27, which asked why builders of automobiles retain the dashboard and other ancient traditions of the horse-drawn carriage, when the same are not only superfluous but unsightly.

Is not the cause to be found in that conservatism which seems inherent in human nature? The inability or indisposition to "get out of the ruts"—the same spirit which inspired the builders of the first steam railway cars to make them as near as possible like the old-fashioned stage coach of the highway, and which induced the manufacturers of electric light

An Automatic Lubricator.

fixtures to copy for years the familiar styles of gas chandeliers and brackets. Adaptation is easier than invention.

C. H. Barney.

New York, July 6.

An Automatic Lubricator.

The lubricator here shown is to be attached to any reciprocating or oscillating parts of engines or machinery requiring constant and reliable lubrication, as the crossheads, connecting rods, eccentric straps, etc., of engines, pumps, air compressors, etc. As it feeds grease instead of oil, it may be attached in any position desired, feeding vertically upward or downward, horizontally or at any angle desired. It feeds only when the part to which it is attached is in motion, and no feeding or loss can occur after the motion ceases.

The base of the lubricator is screwed firmly into the part to be lubricated in the usual way. The body is attached to the base by the union nut or enlarged ring at the bottom. When this is all unscrewed the upper part is all taken off together, the barrel is filled with a charge of grease and returned and securely clamped in the position again by the union nut. The feeding is accomplished by the pressure of the piston, and this pressure is applied by the vibrations of the pendulum seen in front. By the adjustment of the stop screws at the side, the pawl attached to the pendulum may be made to take from one to six or more teeth of the ratchet wheel for each vibration. On the ratchet wheel shaft is a worm which meshes into the large worm wheel at the top. The central screw or spindle is splined and revolves with this wheel at the same time that it travels downward by the operation of its thread in the central nut, which is screwed into the bracket or guide at the top. The feeding goes on if the vibrations continue, until the piston reaches the bottom and the grease is all expelled. To raise the piston for refilling the barrel, the central nut, which has a milled and notched head, is unscrewed from the bracket, the piston is pulled up, the nut is whirled down the screw by hand and screwed tight in its place again. The ratchet wheel may be pulled around by hand, until the slack is taken up and feed is fully established, and if, at any time, it is desirable to feed in an extra quantity of grease, this also may be done by turning the ratchet wheel. The lubricator may be made of any size and for any rate of feed desired. The one here shown will hold about 14 cubic inches or somewhat less than half a pint of grease. The ratchet wheel has 100 teeth, the spindle wheel has 125 teeth. The central spindle is 24 threads to the inch and the travel of the piston is three and one-half inches. If, then, the pendulum is set to take two teeth of the ratchet wheel for each stroke, the number of strokes required to empty the barrel will be: $(100 \div 2) \times 125 \times 24 \times 3.5 = 525{,}000$, and at 200 strokes per minute this would last 2,625 minutes, or, say, 45 hours. Any of the usual kinds of grease may be used in the lubricator, and any percentage of pure graphite may be mixed with it. The worm is of steel, the pawls are of steel, hardened, and the wheels are of hard bronze. The lubricator was designed and patented by G. U. Merrill, of Paterson, N. J., and is made and sold by Jas. L. Robertson & Sons, 204 Fulton street, New York.

Messrs. Irving B. Hiett and H. T. Yaryan, representing the Home Heating and Lighting Company, have let the contract for the heating and lighting plant at Evanston, Ill. The plant fully equipped will cost about $90,000.

Lightning Arresters for Alternating-Current Circuits.

The large amount of capital invested in electrical apparatus has demanded efficient protection from risks of damage and interruption due to lightning. Prior to the introduction of modern lightning arresters, it was found more advantageous to shut down an electrical plant during thunderstorms than to run the risk of continued working, but now lightning arresters are a recognized adjunct of every electric installation.

It is very seldom that overhead wires are actually struck by the lightning discharge, but overhead wires may become electrically charged in three ways; by static induction from the clouds, by dynamic induction from a lightning discharge, and by conduction from the surrounding charged atmosphere. During thunderstorms, and often during fair weather, the atmosphere becomes charged with electricity at a constantly increasing potential as we recede from the earth. At a height of 600 feet, a potential of 3,000 volts has been measured during thunderstorms, and at a height of 1,000 feet a potential of 10,000 volts has been measured. It is well known that lightning is oscillatory. The first oscillation or discharge makes a crack or hole through the atmosphere, and through this the succeeding oscillations take place. About 10 or 12 oscillations can be observed and the time interval is reckoned at about 0.00001 of a second. The lightning being oscillatory and the atmosphere charged, if an overhead wire be charged by conduction from the atmosphere, that is, becomes electrically a portion of it, then with every lightning discharge the potential of the atmosphere would seem to sympathize with the oscillating character of the lightning, and that the charge in the atmosphere would also oscillate and produce oscillations in overhead wires, and in all metallic conductors such as wire fences, rails, etc. Lightning arresters have been known to discharge overhead wires at the rate of 140 times a minute during perfectly fair weather, which shows that wires become heavily charged by conduction from the surrounding charged atmosphere. When the line becomes charged, surgings are set up, there are points of reflection, which are always points of great electrical strain, there are points along the line of varying intensity or tendency to discharge, and these points are constantly shifting their positions, giving rise at places to excessive differences of potential between the line and the earth, and spark-gap lightning arresters are used to conduct such disruptive discharges to earth.

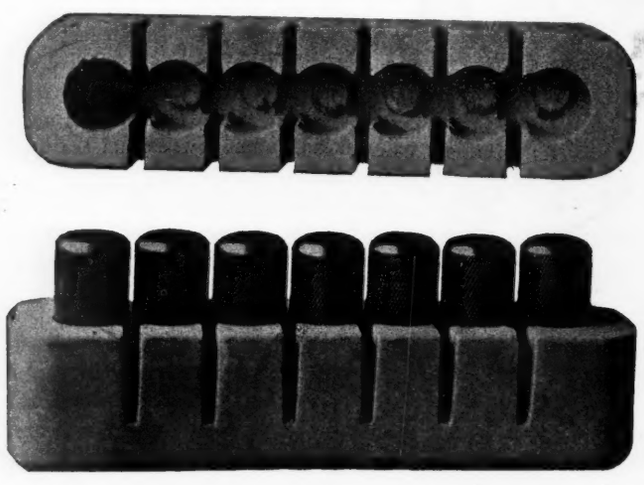


Fig. 1.—Non-Arcing Metal Lightning Arrester.

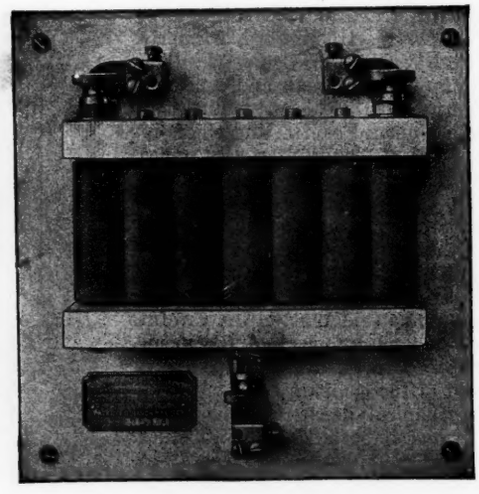


Fig. 2.—Lightning-Arrester Holder.

The lightning arrester now used is a simple spark-gap, one terminal of which is connected to the line and the other to earth. With the modern high-potential circuits, it is found that the dynamo current follows the static discharge across the spark-gap of the arrester, causing a short-circuit or dangerous ground on the line. To avoid this difficulty, arc rupturing devices are attached to the lightning arrester, which interrupt the dynamo current without interfering with the further operation of the lightning arrester as a discharging device. The Wurtz non-arcing lightning arresters manufactured by the Westinghouse Electric and Manufacturing Company were the result of extensive theoretical and practical investigations, with the object of devising arresters which should offer a low resistance path to ground for disruptive discharges, and at the same time operate automatically and repeatedly without moving parts and without interrupting the service. In experimenting upon this apparatus it was discovered that if the electrodes of a lightning arrester were made of zinc, the short-circuiting arc which had heretofore threatened the life of the lightning arrester, absolutely failed to be maintained. A subsequent investigation disclosed the fact that certain other metals exhibited non-arcing characteristics, namely, zinc, bismuth, antimony, lead, magnesium, cadmium and mercury. The discovery of the non-arcing metals solved the problem of the lightning arrester adapted to the requirements of alternating-current circuits. The Wurts arresters for alternating-current currents are known as type "A," type "C," and type "R." The construction of type "A" arrester can be understood by reference to Fig. 1, which consists of seven non-arcing metal cylinders insulated from each other, each one and one-half inches long, and three-quarters of an inch in diameter. The cylinders are mounted on a marble base, the surfaces being knurled, thus presenting hundreds of confronting points for the discharge. When installed the two outer cylinders are connected to either leg of an alternating-current circuit and a central cylinder to earth, thus forming a double-pole lightning arrester —that is, one arrester protects both sides of the circuit. When the lines become statically charged, the discharge spark passes from cylinder to cylinder from the line terminals to the ground. The non-arcing metal will neither sustain an arc nor become fused by it, and all possibility of vicious arcing and short-circuits is thereby avoided. These arresters have no moving parts, no coils to impede the passage of the lightning discharge, and nothing that requires adjustment or inspection. The type "C" arrester is similar to type "A," but instead of being mounted on marble it is enclosed in a weather-proof iron case for line use. The cylinders are placed in porcelain holders as shown in Fig. 2. Both the above types are used for alternating-current circuits

of 1,000 to 1,200 volts; for circuits of 2,000 to 2,400 volts two arresters are used in series; and for 3,000 to 3,200 volts three arresters are used in series.

The purpose of lightning arresters is to offer opportunities for electrical discharge. Since discharges do not pass readily through coils of wire, which therefore act as protectors, properly constructed choke-coils connected in the circuit offer a high resistance to the passage of disruptive discharges, and when used in connection with lightning arresters the combination offers a very reliable means of protecting well-insulated apparatus against lightning. A lightning discharge being of oscillatory character, possesses the property of being greatly impeded self-induction and consequently passes with difficulty through coils of wire; and since the frequency of oscillation of a lightning discharge is much greater than that of commercial alternating currents, a coil can readily be constructed which will offer a relatively high impedance to the passage of lightning, and at the same time allow free passage to all ordinary currents.

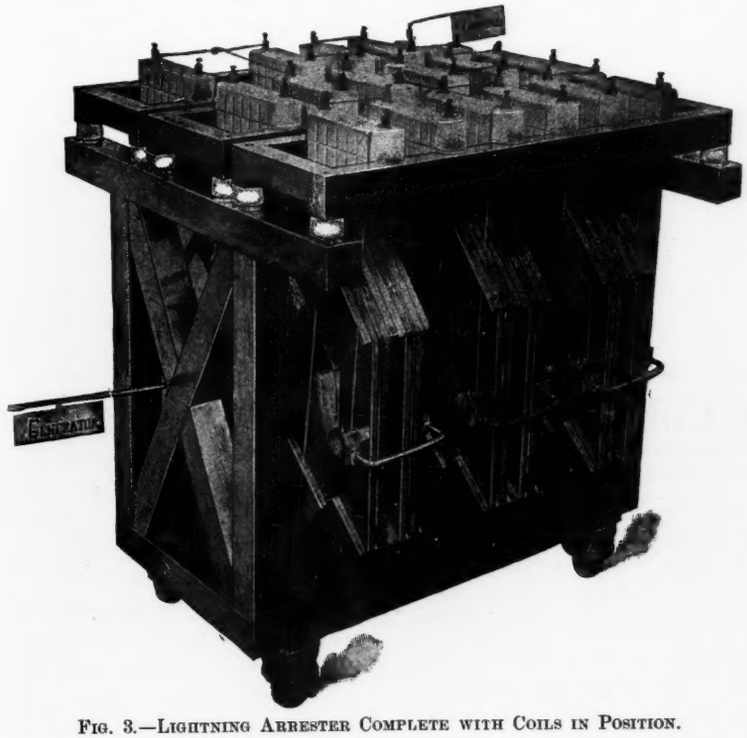


FIG. 3.—LIGHTNING ARRESTER COMPLETE WITH COILS IN POSITION.

Choke-coils are connected in the circuit, used in connection with non-arcing lightning arresters, and offer a very reliable means of protecting well-insulated apparatus, and one particularly well-suited for protecting station apparatus in power transmission systems. Coils can, however, be used to advantage on the lines for the protection of all the electrical machinery of power plants. For ordinary commercial voltages effective protection is obtained with four choke-coils in series in each wire, with four lightning arresters intervening.

The standard form of Wurts arresters for protecting alternating-current, high-potential, power transmission circuits, consists of a combination of a number of units of type "C" non-arcing metal arresters, connected in series and banked with a set of choke-coils, the arrangement of arresters and coils being largely governed by the voltage of the circuit. To economize space and facilitate the proper mounting and connections of the apparatus, the rack shown in Fig. 3 has been designed, which illustrates the type "R" arrester complete, with coils and unit arresters in position, for one end of a wire of 15,000 volts alternating-current circuit. To effectively protect circuits carrying potentials of 10,000 to 15,000 volts it is necessary to use a considerable number of choke-coils and arresters. Where these high potentials are used the circuits are usually of great length, and especially exposed to the effects of lightning, which emphasizes the importance of ample protection.

The apparatus should be installed in a dry place with proper reference to insulation, safety and a good ground connection.

For circuits exceeding 15,000 volts the type "R" arrester is mounted upon a marble panel, and non-arcing metal cylinders are held in porcelain holders on the front of the marble and the choke-coils are mounted upon the back, being secured by marble supports which are supported from the upper part of the panel. This construction affords the high insulating qualities necessary for high voltages and is fire-proof.

Wall Street and the Electrical Stock Market.

The feature of the market during the current week was the fact that Wall street discounted the proceedings of the Democratic convention, at Kansas City, by a rapid advance in prices as soon as it became evident that the Democratic party would again commit itself specifically to the free coinage of silver at the ratio of 16 to 1. The confidence in the present party in power became strong enough to check liquidation and induce purchases of stock on a large scale.

On the New York Stock Exchange, General Electric closed the week at 129 bid and 130 asked, a gain of 2 points for the week. Metropolitan Street Railway closed at 149 bid and 150½ asked, a gain of 4¼ points for the week. Third Avenue Railroad closed at 110 bid and 111 asked, a loss of 1 point for the week. Brooklyn Rapid Transit closed at 55½ bid and 55⅝ asked, a gain of 1⅜ points for the week. Manhattan Railway, of New York, closed at 87½ bid and 87¾ asked, a gain of 1 point for the week.

On the Boston exchange, American Telephone closed at 145 bid and 146 asked. Erie Telephone closed at 96 bid and 99 asked, indicating no change in the price for the week.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Union Traction closed at 37⅜ bid and 37½ asked, indicating no change for the week. Electric Company of America closed at 9¾ bid and 9⅞ asked, a gain of ⅜ point for the week.

On the curb, or outside market, in New York, Electric Vehicle Company closed at 17 bid and 19 asked, a gain of 1½ points for the week. Electric Boat closed at 17 bid and 18 asked, a gain of 4 points for the week.

Wall street, July 7.

A New Wire Manufacturing Plant.

It is rumored that the Washburn Wire Company, heretofore located at Worcester, Mass., has purchased property near the American Electrical Works, at Phillipsdale, R. I., near Providence, and will build on it a large wire manufacturing plant.

At the meeting of the Committee on Public Utilities of the Board of Supervisors, of San Francisco, recently, a proposition was made by Mr. A. E. Brooke Ridley to install an electric light plant in that city for $275,000 and to turn it over to the city at the end of 20 years.

VIEWS, NEWS AND INTERVIEWS

A Portuguese paper gives details of an invention which is to greatly facilitate fox and badger hunting. The device consists of a small electric lamp fixed on to the collar of the dog who is to enter a burrow. The effect of this light, which is to be colored, is expected to have the effect of frightening the animal, which is used to living in its dark hole. It then tries to escape out of the burrow, and the hunter bags him. According to an English contemporary the invention has been patented.

A peculiar difficulty is met with in respect to the telegraph lines in Argentina. The difficulty arises from the quantities of fine web that float through the air, and which, settling on the lines, cause short-circuits the moment the dew falls, or when the weather is at all damp. Everything has been done to remedy the evil, but without avail, and it is now proposed to run an underground cable between Buenos Ayres and Rosario. The difficulty is a very serious one, as it almost puts a stop, at times, to the work of the telegraph department in Buenos Ayres—the number of messages being reduced from 300 to 400 an hour to only 30 to 40.

A friend of the ELECTRICAL REVIEW writes as follows: "I herewith enclose to you a copy of a letter, which I know you will be glad to receive for publication. You have always been an upholder of that which is right to aid the downtrodden people. This Frenchman seems to have been downtrodden by a magnate of the Quebec trolley system. It is time for these giant monopolies to correct indignities such as this poor Frenchman has been put to, and we, ourselves, in this part of America have had many indignities done us by just such men as the Hibernian conductor mentioned in Mr. Jean Thibeaulx's letter. The letter is genuine."

The letter *verbatim et literatim* is as follows:

QUEBEC, 23 March, 1899.

MISSER RUSSELL, ESQ.,

I hope you excuse me for trouble for bring on your notis a littel thing that pass on me the other day last week. I know you hav plenty trouble with the snow and the mans an the peeple but I want for get som satefaction to for the trouble the conducteur mak on me for nothing. It was on car 47 I think, the conducteur she is a small Irishman with black eye and hairs, small back and bid mouth. I ax him with my han on corneur Lac St. Jean Station streete for waite for me an she tell me with his han for go other corneur. Ime fat man and I run like the hell for be there befor the car. I ask him for what he not waite for me an he tell me that his rule and I say fool rule and he say jesut ["cheese it"—Ed.] or some word like that and I say what you say and he say again that his rule, and all the peepul she laf for that ward I expec, and he laf to dam fool, well while the car pass through St. Joseph streete I ax him for let me get of on St. John streete, he giv me peece paper and tell to me with his han for go to car on corneur. I get on car an the conducteur she say to me I mak mistak an she mak me pay five sen mor and I come back again on Lac St. Jean station streete an I coon see John streete. You see what fool that Irishman mak to me—Ime strangee in Quebec an what for your mans not explain mor than that an what for you mak the peepul run like that. That is a bole man that Irishman an I hope you go mak him pay for that—give him good pinch for mak me run like that—he mak the fool to me, you mak the fool to him dam fool.

Excuse I not speeke in henglish to much.

Your verry truly friend,
Jean Thibeaulx,
St. Michael.

ELECTRIC RAILWAYS

The International Tramways Exhibition, which was opened in London on June 23, furnishes a striking evidence of the United States domination of the traction-equipment industry. Nine-tenths of the exhibits represent American patents.

The Lockport & Olcott Railway, which is to operate an electric road 18 miles long on a previous right of way from Lockport, N. Y., to Olcott, has received the approval of the State Board of Railroad Commissioners of a proposed issue of a first mortgage for $1,000,000.

The Hutchinson Electric Railway Company, new corporation, is to run an electric line from New London to Berlin, touching Royalton and Weyauwega, Wisconsin. Power is to be furnished by the Ostrander dams. The company is now asking for franchises.

Officials of the Metropolitan Street Railway Company, of New York city, say it is not likely that electric cars will be running on the Broadway and Lexington avenue lines before early Autumn. While most of the excavating work necessary to the laying of the ducts has been completed, there is yet much to be done before cable cars can be banished from the main arteries of the city.

At the meeting of the stockholders of the United Traction Company, of Albany, N. Y., the following directors were elected: Robert C. Pruyn, Francis N. Mann, Jr., Anthony N. Brady, William Kemp, A. Bleecker Banks, Charles Cleminshaw, John G. Myers, Edward Murphy, Jr., Simon W. Rosendale, William Shaw, John W. McNamara, James O'Neil, James H. Manning, William J. Walker, George P. Ide.

An important consolidation of Northern Ohio electric railway interests has been recorded in the office of the Secretary of State, the Cleveland, Elyria & Western Railway Company being formed by the consolidation of the Cleveland, Berea, Elyria & Oberlin Railway Company the Lorain County Railway Company and the Oberlin & Wellington Railway Company —all being electric traction companies. The capital stock of the combined company is fixed at $2,000,000.

The promoters of the Portage Lakes Transit Company claim to have the necessary consents for the construction of the proposed electric line from Bedford, Ohio, to Ravenna and Kent, and will apply to the County Commissioners for a franchise. The route is from Bedford to Hudson and Brady Lake, *via* private right of way, touching Twin Lakes and Pippin Lake. A "Y" at Brady will enable cars to reach both Kent and Ravenna direct. Frank Rockefeller, of Cleveland, it is claimed, will furnish most of the capital.

The Illinois & Wisconsin Railroad Company has been incorporated at Springfield with a capital stock of $100,000. The new line will run between Morris, Grundy County, and Lake Geneva, a distance of 110 miles, and there connect with the proposed Milwaukee & Lake Geneva Road. It is estimated that the line will cost, when completed, $1,500,000. Electricity will be the motive power, and both freight and passenger traffic will be handled. The passenger equipment will be similar to that used on the elevated roads of Chicago.

The Kokomo, Ind., Wabash & Lake Manitau Railway Company, composed of Ohio, Wabash and Rochester men, will soon file articles of association. The company is formed to build a trolley line from Kokomo to Rochester, *via* Greentown, Converse, Wabash, Roann and Akron. The right-of-way has been obtained along the entire route, and negotiations are now on for financing the road. Franchises have been granted in all the towns on the line, and the promoters say that the enterprise is certain to go. The road will be about 60 miles long, and traverse a populous and wealthy region. Surveys and profiles are now completed, and estimates are soon to be asked on the construction work.

High-Tension Oil-Enclosed Circuit-Breakers.

The question of safety devices to open very high-tension circuits when overloaded has engaged the attention of inventors and engineers since the first installation of long-distance transmission and other plants requiring high voltage. The conditions under which such apparatus have to work are such that the break must be instantaneous, and preferably in a medium of greater dielectric strength than air, for high potentials can jump a considerable distance in air and a short circuit by a heavy current produces an arc that will almost immediately destroy any kind of a switchboard.

The circuit-breaker device illustrated herewith is one that has been produced by the General Incandescent Arc Light Company, of New York, for high-tension alternating polyphase systems. The circuit is broken entirely under oil. The switches are made with or without the automatic overload feature, and can also be furnished with a device for closing them from a distance by a push button. The high tension parts are all installed behind the switchboard, and no parts carrying a high voltage current are on the front of the board where they may come in accidental contact with the person. Fig. 1 shows a circuit-breaker of 200 amperes capacity made for a three-phase, 6,600-volt system, and Fig. 2 shows a toggle arrangement placed on the front of the board for handling the switches. The apparatus is highly finished and carefully constructed and has demonstrated its value in hard practical work in several installations.

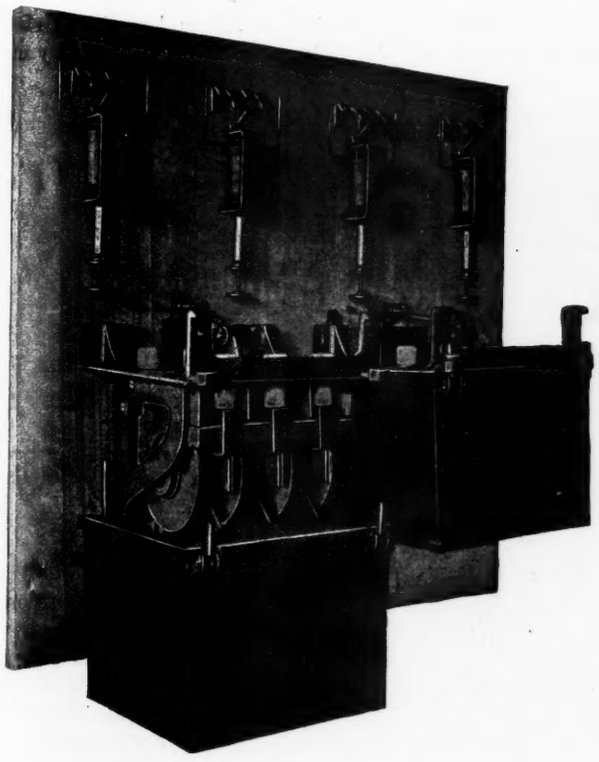


FIG. 1.—TWO HUNDRED AMPERE OIL-ENCLOSED CIRCUIT-BREAKER.

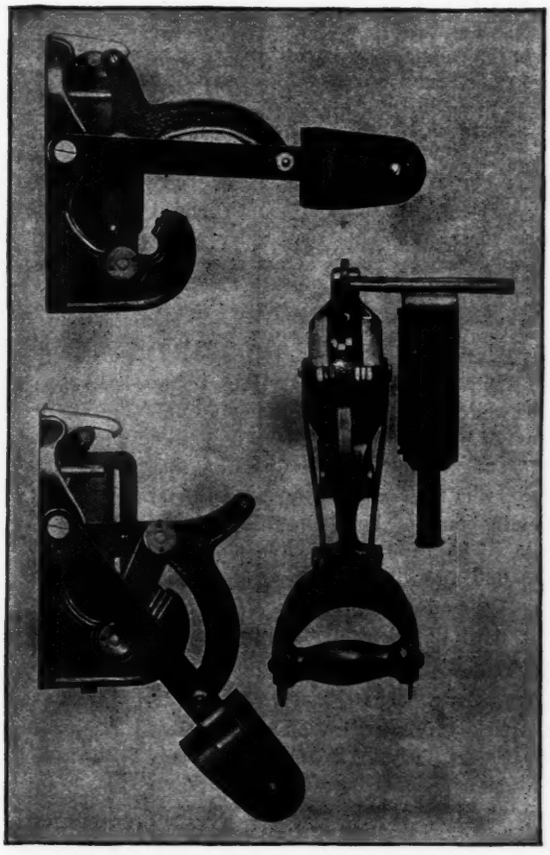


FIG. 2.—TOGGLE ARRANGEMENT FOR CIRCUIT-BREAKER.

Serious Electric Railway Accident at Tacoma.

In a Fourth of July electric railway accident, at Tacoma, Wash., 41 persons were killed outright and 62 were injured. A car loaded with men, women and children from South Tacoma and Spanaway Lake jumped the track at a high bridge over a gulch, at Delin and D streets, in Tacoma. The car turned completely over as it went through the air, and landed 75 feet below the bridge on its top. The weight of the trucks on the floor of the car crushed the unfortunate passengers. At the point where the car jumped the bridge there is a sharp turn in the track just as it goes on the bridge; owing to the high speed of the car it was turned over as described above. The car was so badly overcrowded that it got beyond the control of the motorman and the brakes failed to check its speed.

PERSONAL.

Mr. James F. Cummings, the well-known conduit inventor and underground expert, returned to New York city on the Oceanic last Saturday after several weeks spent in Europe. Mr. Cummings expects to sail for England on July 21.

Mr. David Bowes, who has been identified with the Chicago & Alton Railway has been promoted to the position of Assistant General Passenger Agent of that company, and his headquarters will continue at St. Louis. The ELECTRICAL REVIEW extends congratulations to Mr. Bowes for this deserved recognition of his experience and efficiency as railway official.

An independent telephone company is being organized in Oakland County, Michigan, to give toll rates to every point in the county for five cents where now in some cases they are as high as 30 cents. By December the company expects to have every town and hamlet in the county connected. The organizers think this is the solution of the telephone question—each county to organize its own company. The old company recently advanced the Detroit-Pontiac rate from 10 to 35 cents.

TELEPHONE AND TELEGRAPH

The Erie telephone system made a net gain of 2,744 subscribers in June. The total number connected on June 30 was 126,455. The number waiting connection was 6,073.

The Colorado Telephone Company has filed amended articles of incorporation. The capital stock of the company is increased to 60,000 shares of a par value of $50 a share, the capitalization being increased from $1,500,000 to $3,000,000.

The Pacific States Telephone Company made a net gain of 1,297 subscribers in June. The total number now connected is 76,490, which includes 19,106 in San Francisco. The development of San Francisco is now within one per cent of the Swedish development.

The output of the American Bell Telephone Company for the month ended June 20 shows:

	1900	1899	1898
Gross output	55,613	61,399	23,971
Returned	25,671	15,668	9,650
Net output	29,942	45,731	14,321
Since December 20:			
Gross output	346,146	341,026	166,333
Returned	132,660	91,737	73,295
Net output	213,486	249,289	93,038
Total outstanding	1,793,991	1,374,539	1,012,159

The People's Home Telephone Company, of Birmingham, Ala., was organized at Youngstown, by capitalists of that place, who will establish an exchange at Birmingham and build lines through the state. The capital of the company is $200,000, and will be increased as the business demands. The officers of the company are: President, H. H. Stambaugh; secretary and manager, S. B. Claypool; treasurer, A. Adams.

Articles of incorporation of the Mendon Centre, N. Y., Telephone Company have been filed in the office of the Secretary of State, at Albany. The company proposes to maintain telephone wires from Mendon Centre to Honeoye Falls, and south thereof. The capital is $600 and the directors are: E. H. White, B. H. Cole, A. A. Lord, George Finigan, F. E. Lord, L. B. Lord, H. M. Davis, W. L. Terry and V. J. Townsend.

American Telephone and Telegraph rights expired June 30. No announcement as to the amount of American Bell Telephone stock that has been transferred for Long-Distance stock has been made by the management, but it is understood that the bulk of the outstanding Bell stock has been turned in in exchange for the new shares. The action of the directors in declaring the dividend for the present quarter payable on Long-Distance stock and not on Bell stock, undoubtedly stimulated the transfer of shares.

A number of St. Paul and Minneapolis capitalists have, it is reported, interested themselves in the Mississippi Telephone Company to the extent of $500,000. The company includes the Mississippi plants in both St. Paul and Minneapolis, and the two exchanges include about 2,500 telephones. J. C. Hubinger, of Keokuk, Ia., is the president of the company, and it is said that he will retain his interest. The names of the purchasers are not revealed. Under the company's charter, its property in St. Paul, if disposed of within five years, must be sold to the city.

The Union Telephone Company was incorporated recently with the Secretary of State of New York to operate its lines as follows: From Glens Falls to Caldwell, Warrensburgh, Chester and Luzerne, Warren County; to South Glens Falls, Moreau, Corinth and Hadley, Saratoga County; to Sandy Hill and Fort Edward, and Kingsbury, Hartford and Granville, Washington County, and from Glens Falls down the Hudson River to Albany and Troy. The capital stock is $100,000, divided into shares of $10 each, and the directors are: Byron B. Fowler, Louis M. Brown, Arnold Wurtenburg, Daniel L. Robertson, E. B. Potter and Charles W. Cool, of Glens Falls; W. A. Huppuch and James E. Flood, of Sandy Hill, and A. E. DeForest, of Fort Edward.

The Missouri & Kansas Telephone Company will spend over a million dollars in extensions out of St. Joseph, Mo., this year. The appropriation was made by the company some time ago and the work has already begun. Contracts have been let for an air line running directly west of St. Joseph for a distance of 160 miles. Troy, Hiawatha, Sabatha, Seneca, Marysville and Washington and intermediate Kansas towns will be on the new line. It is expected that the line will be pushed on to Denver. Diverging from this main will be branches which will take in towns within easy reach. When these are finished northern Kansas will be covered with a network of Bell telephone wires. The service will be extended to the counties of Brown, Doniphan, Nemaha, Marshall, Washington, Arapahoe, Clay and Cloud within a few months. From Kansas City a belt line is being built to connect with the main line out of St. Joseph. This will place a large number of Kansas towns in communication with one another, as well as with the two principal cities of the West.

A New Subway Manhole Cover.

In the illustration herewith is shown the Faller manhole cover for subway manholes. This is a recently patented device, which, it is stated, forms a double water seal confining a column of air under pressure with the idea of keeping the water out of the manhole. It is said that the device accomplishes this result, and that it is at the same time very simple and durable. Its simplicity and quickness in handling, both to open and close, are claimed to be meritorious advantages. The device is controlled by Mr. J. W. Chisholm, of Washington, D. C.

A New Subway Manhole Cover.

A Possible Electrical Consolidation.

It is now rumored that negotiations are under way for the consolidation of the Warren Electric Manufacturing Company, of Sandusky, Ohio, with one of the most important manufacturing electrical concerns in the East. The Sandusky company is the maker of the popular Warren alternating machines. The following are the names of the company's officers: C. C. Warren, president; Jos. F. Kilby, vice-president; Frank Warren, secretary, and Chas. F. Mack, treasurer.

CORPORATION NEWS

BOONE, IOWA—The Boone Telephone Company filed articles increasing its capital stock from $30,000 to $75,000.

NACOGDOCHES, TEX.—The Texas Gulf Telephone Company, of Nacogdoches, has been organized with a capital stock of $10,000. Incorporators: E. C. Branch, George H. Davidson and K. P. Branch.

BRENHAM, TEX. — The Brenham & Brazos Valley Telephone Company, of Brenham, has been chartered with a capital stock of $2,000. Incorporators: D. C. Giddings, Jr., W. M. Aren and O. A. Seward.

WEBSTER CITY, IOWA—The Chamberlain Independent Telephone Company, of Webster City, has filed articles of incorporation. Its capital stock is $20,000. A. W. Chamberlain is president and treasurer, and J. W. Lee, secretary.

RHINEBECK, N. Y.—The Dutchess Light, Heat and Power Company, of Rhinebeck, has been chartered to manufacture electricity. Capital, $20,000; directors: George N. Miller, Thaddeus A. Traver and Frank Herrick, Rhinebeck.

GREENSBURG, IND.—The Decatur County Telephone Company, of Greensburg, has been formed to operate telephone lines. Capital, $30,000; incorporators: J. Shanks, M. Spilman, J. G. Dormill, W. E. Jackson, J. S. Shaw, all of Greensburg.

BUFFALO, N. Y.—The Kensington Automobile Manufacturing Company, of Buffalo, has been chartered to manufacture automobiles. Capital, $600,000; incorporators, W. J. Knowles, C. G. Shepard, J. A. Roberts, H. P. Bissell, all of Buffalo.

MIDDLETOWN, N. Y.—The Neversink Light and Power Company, of Middletown, has been chartered to manufacture electricity and gas for light, heat and power. Capital, $100,000; incorporators: P. A. Rorty, W. J. Burke, H. C. McBriar, all of Middletown.

GILSONBURG, OHIO—The Gilsonburg Electric Light Company, of Gilsonburg, has been incorporated to furnish electricity for light, heat and power. Capital, $12,000; incorporators: H. W. Mohroff, F. H. Westhoff, C. Sanders, L. Gerwin, H. Feehrmeyer, A. Miller.

COLORADO CITY, COLO.—The Colorado City Electric Light and Power Company has been incorporated with a capital of $10,000. Charles M. Sherman, Charles L. Cunningham, Charles E. Corcoran, Morton Drake and John R. Watt, Colorado City, are the directors.

GLENS FALLS, N. Y.—The New Union Telephone Company has been chartered to operate between Glens Falls, South Glens Falls, Sandy Hill, Fort Edward and the adjacent towns and to Albany and Troy. Capital, $100,000; directors: B. B. Fowler, L. M. Brown and Arnold Wurtenberg, Glens Falls.

PITTSBURGH, PA. — The Pittsburgh Electrical and Machine Works, of Pittsburgh, has been incorporated for manufacturing electric appliances. Capital, $60,000; incorporators: C. Schuster, F. Marzolf, both of Bellevue; C. K. Bergmann, H. C. Haslage, J. M. Goehring, all of Allegheny City.

CEMENTON, PA.—The Cementon Electric Light and Power Company, of Cementon, has been chartered to furnish light, heat and power. Capital, $10,000; incorporators: J. S. Wentz, of Mauch Chunk; G. D. M. Creary, W. B. Whitney, both of Philadelphia; A. C. Leiseming, of Upper Lehigh; T. M. Righter, of Mt. Carmel.

SLATEDALE, PA.—The Slatedale Street Railway Company has been chartered to operate a street railway between Slatington and Slatedale, Lehigh County. The length of the road is about four miles. The capital stock is $50,000. The incorporators are: Francis J. Crilly, John L. Schwartz, Patrick F. Cannon, Francis A. Kreitz and Walter J. Sager, all of Allentown.

NEW YORK CITY—The Richmond County Power Company, of the borough of Richmond, has been incorporated to supply electricity for producing light, heat and power. Capital, $500,000; directors: Samuel Thomas, Wm. E. Findlay, New York city; Morgan L. Ryan, New Brighton; Frederick T. Lewis, Arthur B. Proal, Jr., Norman P. Findley and J. H. Swinarton, West New Brighton.

LAPORTE, MICH. — The Laporte & Michigan City Railway Company has been incorporated with headquarters in Laporte. Its capital stock is $300,000. J. A. Brett, of Chicago, is president of the company; A. L. Searle, of Chicago, is secretary, and L. B. Bradley, of Chicago, is general manager. The other directors are: A. M. Hewes, of Chicago, and M. H. Weir, E. F. Michael and L. T. Harding, of Laporte. The company will operate an electric railway between Laporte and Michigan City, a distance of about 14 miles. The road will be built this Summer.

GALVESTON, TEX.—In the suit of the Massachusetts Loan and Trust Company *vs.* the Citizens' Electric and Power Company, of Houston, United States District Judge Bryant has issued an order postponing the sale of the plant of the Citizens' Electric and Power Company until the first Monday in October, 1900. In the same suit the Judge ordered the receiver of the Citizens' Electric and Power Company to institute suit against the city of Houston on the common law docket for $34,344.04, alleged to be due the receiver by the city of Houston for street lights furnished by the receiver to the city.

CLEVELAND, OHIO—An important consolidation of northern Ohio electric railway interests has been accomplished, the Cleveland, Elyria & Western Railway Company being formed by the consolidation of the Cleveland, Berea, Elyria & Oberlin Railway Company, the Lorain County Railway Company and the Oberlin & Wellington Railway Company—all being electric traction companies. The capital stock of the combined company is fixed at $2,000,000. The directors are: A. H. Pomeroy, of Berea; S. C. Smith, of Cleveland; Will Christy, Akron; M. A. Sprague, Berea; L. M. Coe, Berea; F. L. Fuller, Elyria; H. Q. Sargeant, Cleveland; M. J. Mandelbaum, Cleveland; O. D. Pomeroy, Berea, and F. T. Pomeroy, Cleveland. The officers are: A. H. Pomeroy, president; A. E. Atkins, vice-president; E. F. Schneider, secretary and F. T. Pomeroy, treasurer.

EDWARDSVILLE, ILL.—Articles of incorporation have been issued to the St. Louis & Illinois Electric Railway Company, with its principal offices located at Edwardsville. The capital stock of the corporation is $2,500 and the object is to construct an electric railway from East St. Louis, St. Clair County to Edwardsville, Madison County, by way of Collinsville, Venice, Granite City and Horse Shoe Lake; with a branch from Collinsville to Belleville; a branch from Venice to Edwardsville and Highland, by way of Glen Carbon, in Madison County, and a branch from Collinsville, in Madison County, to Lebanon, in St. Clair County. The incorporators and first board of directors are: Ferdinand Vorwald, C. N. Travous, W. M. Warnock and George D. Burroughs, of Edwardsville, and Fred Kohl, Theodore F. Meyer and A. H. Smith, of St. Louis.

The Progress of the Electric Railway.

[From the Boston News Bureau.]

The transformation of the street railways of the country from horse power to electricity has been the work of scarcely a decade. The close of 1899 found in this country 871 roads, with upwards of 19,000 miles, of which less than 500 miles were of the old-fashioned system. New England has reduced her mileage of horse railways to only eight miles.

Total mileage of street and elevated railways at the close of 1899, was 19,213 miles; number of cars, 58,736; capital stock, $1,023,819,987; funded debt, $777,862,571; total, $1,801,682,558. The increase of liabilities of 1899 over 1898 was $198,682,899, for both capital stock and debt, indicating a year of activity.

New England's share in the above was 2,997 miles of railway; 10,652 cars with capital stock and debt of $123,673,000. Massachusetts occupies the commanding position in New England, with 1,625 miles of railway; Connecticut has 492 miles; Maine, 279 miles; Rhode Island, 181 miles; Vermont, 71 miles, and New Hampshire, only 57.

INDUSTRIAL NOTES

The Electric Appliance Company, Chicago, reports large sales of Dayton fans and claims that if the orders keep up during all the season that it will be a record-breaker in the fan business.

The Western Electrical Supply Company, St. Louis, Mo., is agent for a complete system of series alternating enclosed arc lighting. It announces that it has for prompt shipment arc lamps and automatic series transformers.

The New York & Ohio Company, Warren, Ohio, manufacturers of the Packard incandescent lamps, is distributing in its calendar series for the month of August a well-engraved print by the chemigraph process of the painting by Emanuel Spitzer "Auditing the Market Bill."

The Indianapolis Arm, Bracket and Pin Company, Indianapolis, Ind., has acquired from J. B. Magers, Jamestown, Ind., the business previously controlled by him, for the manufacture of telephone and telegraph insulator pins and brackets and general wooden materials for electrical purposes.

The Bullock Electric Manufacturing Company, of Cincinnati, Ohio, distributed at the recent Master Mechanics' and Master Car Builders' Conventions, at Saratoga, N. Y., a very handsome souvenir, showing pictures of its apparatus and various departments of its manufacturing plant.

Lea Electric Manufacturing Company, Elwood, Ind., is introducing an arc lamp which is claimed to embody several interesting improvements. This company announces that it will send, on request, a copy of its artistic arc lamp catalogue. The company is represented by W. R. Garton & Company, Chicago.

Mr. John T. McRoy, the well-known conduit manufacturer, of New York and Chicago, is sending out his monthly calendar and blotter for July. These blotters have become a feature of Mr. McRoy's advertising, and are always up-to-date. The newest ones contain comments upon "Boxers" of several sorts.

The John A. Roebling's Sons Company, of New York, through Mr. Henry L. Shippy, treasurer, has sent to its friends a neat pencil sharpener, with the request that after the pencil has been sharpened the recipient write to the company for information and quotations on any kind of iron rope, iron, steel or copper wire.

The Chicago Mica Company, Valparaiso, Ind., is now well under operation in its new factory. The company says that it now has 34,500 square feet of floor space in use in comparison with 500 square feet in use in 1898. This company, in addition to producing mica for all electrical purposes, manufactures the "Peerless Crystal" insulating varnish.

The Chicago & Alton Railway, through its traffic department, is sending out some novel advertising matter in the form of illustrated correspondence. The letters are tastefully prepared and are signed by Mr. George H. Charlton, general passenger agent of the road. The letters bear date of Chicago, and may be obtained by addressing Mr. Charlton as above.

The Shelby Electric Company, of Shelby, Ohio, manufacturer of the well-known Shelby incandescent lamps, is sending to all of its customers a printed sheet to be tacked on the door of the dynamo room, showing what to do in case of accidental electric shock. The idea is a good one, and will doubtless be greatly appreciated by the Shelby company's customers.

The Crown Woven Wire Brush Company, Salem, Mass., announces that users of commutator compounds have received samples of the "Crown" commutator compound and universally have stated that it has proved satisfactory wherever used on their dynamo and motor work as a lubricant. The above firm is accordingly in receipt of several large orders from those who have made tests of the compound.

The Continental Electric Company, Boston, makers of the Continental arc lamp, claim that by cutting out all dead resistance they obtain the following results with this lamp: 96 volts at arc with 108 volts at mains, 100 volts at arc with 112 volts at mains, 104 volts at arc with 116 volts at mains. This company has recently issued descriptive bulletin No. 2, which is of interest to electric light investigators.

The Emerson Electric Manufacturing Company, St. Louis, Mo., informs the ELECTRICAL REVIEW that it has sold and transferred its switch and switchboard department to the Frank Adam Electric Company, who will continue the manufacture of the switches, switchboards and tablet boards formerly made by this company. This move is made because the Emerson Company wishes to give its entire facilities to the production of electric motors.

Armour Packing Company, Kansas City, Mo.; Grand Crossing Tack Company, Grand Crossing, Ill.; Diamond Rubber Company, Akron, Ohio; the B. F. Goodrich Company, Akron, Ohio; Honolulu Rapid Transit and Land Company, Honolulu, H. I., have, after careful investigation of all devices, awarded contracts to the Siegrist Lubricator Company, of St. Louis, Mo., to equip all of their machinery with the Siegrist automatic oiling system.

"Electric Fans for Battery Currents" is the subject of a little booklet issued by the Edison Manufacturing Company, 135 Fifth avenue, New York city. These battery fan motor outfits are made in several types and sizes and are most satisfactory and serviceable for use where the Edison current is not available. This company manufactures a special design for use in telephone booths, and also types of fan motors designed for the 110 to 120-volt direct current, the 115-volt current, or the 220-volt current.

The Edward P. Allis Company, of Milwaukee, Wis., as is well known, has developed a very large and growing export trade in steam engines for electric lighting and railway plants. This company has become so well known, especially in Great Britain, that the London *Times* recently devoted a column of its valuable space to an account of this company's work in the British Isles. The point that seemed to impress the London *Times* was that an American manufacturer over 1,000 miles from the nearest seaport on this side of the Atlantic could compete and secure from British competitors a contract for the steam engines in the Glasgow tramways power plant.

The Morris Electric Company, New York, reports the following items of interest as being some of its recent installations and sales: Apparatus, including all elements necessary for complete construction, have been shipped to Trinidad, West India Islands, for an electric light plant; the company has recently chartered a ship and sent 1,500 yellow pine poles to Havana, also material for constructing an entire electric light and power plant in Havana; three carloads of telephone cross arms have recently been sent to Rochester, N. Y., for the Rochester Telephone Company; 85 carloads, in addition to the previous order of one entire ship's cargo, of underground conduits, of the "Potomac" type, sent to Havana, Cuba; for the Plainfield & Westfield Electric Railway, in New Jersey, the company has recently sent apparatus for the construction of the overhead portion, and also iron poles for the whole system; for the Lehigh Telephone Company, Altoona, Pa., a large consignment of "Potomac" conduit construction material; an order for 300 car-wheels for Mexico has recently been filled; an order filled for the Buffalo, Aurora & Hamburg Electric Railway, for all overhead materials to be used on that line. The company has received an order for a large installation of "Monarch" arc lamps; they also recently chartered a vessel and sent a full cargo of coal to Havana, Cuba, for the electric lighting plant in that city. These are only a comparatively small part of the commissions executed by this energetic firm, and the announcement shows the splendid activity of both the foreign and domestic electrical field. The company's new factory for the production of the Morris stranded flexible rail bond has been running practically to its capacity, and large shipments have been made of this bond to New England, the West, Mexico and foreign countries.